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FEDERATED MALAY STATES.

MEDICAL REPORT FOR THE YEAR 1914.

VITAL STATISTICS.

In the early part of the year there was some reduction in population, and since August immigration has been stopped and a large exodus of people has taken place, therefore, to estimate population for the purpose of calculating death-rates and birth-rates with anything like accuracy is not advisable—there is no means of obtaining reliable figures and guesswork totals are not of any real value or to be recommended—two examples of interference with the normal increase of population are:

(i) Twenty-two thousand and six Indian immigrants were quarantined in Port Swettenham during 1914, whereas 62,193 was the number in 1913.

(ii) Twelve thousand and ninety-three Chinese were passed through the Camp for repatriation during 1914 and none in 1913, and there is no record of those who left this country without Government assistance. Taking all these difficulties into consideration it will be seen that estimation of population with any degree of accuracy is not advisable.

BIRTHS.

Year.	Total.
1911	20,310
1912	25,426
1913	26,349
1914	27,978

There were 5,514 deaths of infants under one year of age, showing an infant mortality of 197.85 per mille. In 1913, the infant mortality was 221.6 per mille.

Year.	Deaths.	Per mille.
1911	3,485	171.58
1912	3,554	139.97
1913	5,840	221.6
1914	5,514	197.85

DEATHS.

Year.	Total.
1911	38,732
1912	40,961
1913	38,000
1914	39,003

The death-rate of the principal townships are thus shown:

	Population.	Crude death-rate per mille.	Corrected death-rate per mille.
Kuala Lumpur	58,107	54.42	33.89
Ipoh	27,675	51.8	30.8
Taiping	21,577	70.97	45.78
Seremban	10,594	116.57	63.9

The crude death-rate is calculated on the total number of deaths within Sanitary Board limits. The corrected death-rate is calculated after excluding the deaths of those persons known to have been at date of death resident for less than 30 days within Sanitary Board limits.

The town population have not been so much interfered with during the last half of the year and the death-rates are therefore submitted with some confidence.

PRINCIPAL CAUSES OF DEATHS.

Malaria fever accounts for 13,634 deaths or 34.95 per cent. of the total deaths.

The deaths and mortality rates from malaria fever for the past four years are set out below:

Year.	Deaths.	Per cent.
1911	17,440	45.02
1912	17,870	44.02
1913	16,414	43.19
1914	13,634	34.95

Twenty-nine thousand seven hundred and twenty-seven cases were treated in the different hospitals in the Federated Malay States, with 1,793 deaths, as compared with 31,456 cases and 1,931 deaths during the previous year.

It is satisfactory to note improvements in the malaria figures for the different hospitals have been maintained and there has been a slight decrease in the number of victims from this malady, but the loss of life caused by this disease is very serious in a population of a little over one million. The actual mortality figures do not represent all the mischief caused by malaria—because an infected person is an easy prey when attacked by other diseases—the eradication of malaria would mean a low death-rate, higher birth-rate, and fewer infantile victims. Financial conditions have necessarily interrupted some anti-malarial operation, but it is to be hoped that immediately money is available, no delay will be made in continuing to prosecute a vigorous campaign against a preventible disease, the presence of which, in anything like the extent disclosed, should be reckoned a reproach to a Government if not very much reduced in the near future. It is noteworthy that general interest in the subject of malarial prevention still prevails, and it appears to me that there is a fairly large number of people convinced that the disease has got to be tackled vigorously and there are many who are ready to undertake operations either independently or in co-operation with Government. Some very satisfactory work has been done on rubber estates with good results, and the report of the Malaria Advisory Board shows that what has already been undertaken continues to be very satisfactory. The distribution of quinine in tabloid form accompanied by a leaflet, giving instructions in two vernaculars as well as English, has been continued and reports have been sent that it is very much appreciated and gives good results. The reduction in deaths from malaria may be reasonably attributed to anti-malarial measures and distribution of quinine.

Dysentery and diarrhœa was the registered cause of death in 5,235 cases or 13.42 per cent. of the total deaths:

Year.	Deaths.	Per cent.
1911	7,451	19.23
1912	5,939	14.51
1913	5,317	13.91
1914	5,235	13.42

The total treated in hospitals were as follows:

Year.	Cases.	Deaths.
1913	5,559	1,326
1914	5,982	1,429

Beri-beri accounted for 1,223 deaths or 3.13 per cent. of the total deaths:

Year.	Deaths.	Per cent.
1911	1,469	3.79
1912	1,217	2.99
1913	1,190	3.13
1914	1,223	3.13

Cases treated in hospitals:

Year.	Cases.	Deaths.
1911	6,042	695
1912	5,676	657
1913	6,409	716
1914	6,240	686

Pulmonary tuberculosis accounted for 1,655 deaths or 4.24 per cent. of the total deaths:

Year.	Deaths.	Per cent.
1911	2,300	5.93
1912	1,354	3.33
1913	1,623	4.27
1914	1,655	4.24

The number treated in hospitals were:

Year.	Cases.	Deaths.
1913	1,771	884
1914	1,786	849

The Senior Medical Officer, Perak, remarks—"It is impossible to persuade natives to seek admission in the early stages and without the intelligent co-operation of the sufferer a campaign against the insidious and elusive tubercle bacillus could not be undertaken with much prospect of success."

Pneumonia accounted for 1,081 deaths, equal to 2.77 per cent. of the total deaths:

Year.	Deaths.	Per cent.
1913	1,204	3.16
1914	1,081	2.77

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Convulsions accounted for 3,136 or 8.04 per cent. of the total deaths:

Year.	Deaths.
1913	3,054
1914	3,136

SMALL-POX.

Perak.—Eighteen cases occurred during the year with four deaths as against 134 cases with 38 deaths in 1913.

Selangor.—Sixty-two cases of small-pox occurred in the State during the year with seven deaths, including one European.

Negri Sembilan and Pahang.—Of the dangerous infectious diseases these States were particularly free. No cases of cholera or plague were reported during the year, only two cases of small-pox—one in Kuantan and one in Pekan—the latter was imported from Singapore on the last day of the year. Last year 36 cases with 13 deaths were recorded for Pahang.

CHICKEN-POX.

Perak	15
Selangor	7
Negri Sembilan	2
Pahang	—

MEASLES.

Perak	17
Selangor	15
Negri Sembilan	4
Pahang	298

An epidemic of measles broke out in the mukims of Pengor, Tulong and Tamai Pekan in August and September and continued into October and November. There were in all 298 cases with one death. Persons of all ages were attacked from six months to 50 years old.

CHOLERA.

	Cases.	Deaths.
Perak	506	230
Selangor	57	53
Negri Sembilan	—	—
Pahang	—	—
Total	563	283

as against 26 cases and 17 deaths in 1913. The outbreak at Lower Perak was a severe epidemic, a special Medical Officer and the Health Officer, Perak North, were on cholera duty for some time on the Perak river from Parit to Telok Anson. In Kinta the majority of cases occurred at Batu Gajah Gaol and were transferred to the Isolation Hospital.

In Selangor, 51 cases with 47 deaths occurred at Sabak Bernam, and six cases, all fatal, at Quarantine Camp, Port Swettenham.

Year.	Cases.	Deaths.
1911	620	462
1912	29	16
1913	26	17
1914	563	283

ANKYLOSTOMIASIS.

	Treated.
Perak	1,898
Selangor	1,180
Negri Sembilan	534
Pahang	219
Total	3,831

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1914

The Senior Medical Officer, Perak, reports that admission for ankylostomiasis are rapidly increasing as compared with the figures for the past three years. Every case of ankylostomiasis is diagnosed microscopically.

Dr. Hart states that a systematic examination of all patients admitted to Kuala Pilah Hospital showed that 50 per cent. of Malays, 30 per cent of Tamils, and 25 per cent. of Chinese harboured the worms.

Year.	Cases.
1911	2,225
1912	2,485
1913	3,150
1914	3,831

The figures for this disease would make it appear that there is an increase in its prevalence, although I am not prepared to assert that it is not so, yet it should be noted that from the latter part of 1913, I specially asked for a more systematic investigation of the excreta of patients admitted to hospital and this has disclosed the presence of the ankylostome in many more people than were suspected of harbouring the worm—the figures for 1915 and 1916 will give more accurate information regarding increase or decrease. Amongst Europeans in other countries ankylostomiasis produces very marked symptoms, causes great distress to the individual, and is a very serious disease—its ravages in certain States of America, amongst Cornish miners and Italian labourers, roused attention and necessitated very careful investigation and thorough treatment. As far as observation goes Eastern races do not suffer so acutely, in large numbers, they show a certain amount of anæmia and debility and naturally possess less resistance to other diseases because of this anæmia and debility; therefore it is a great benefit to them to be relieved of the worm. More general attention is being paid to the treatment of the disease and prevention of infection; in addition, a systematic investigation of its prevalence is contemplated in the coming year. The impression appears to be that doses of chenopodium oil give the best results. It is seldom wise to attach little importance to a disease because for a time it happens to cause less serious results in a place than might be expected from the experience of people in other countries—diseases so frequently develop in intensity—therefore the more careful attention paid to it during 1914, and what is being arranged for 1915, deserve every encouragement.

ENTERIC.

	Cases.	Deaths.
Perak	11	4
Selangor	52	24
Negri Sembilan	6	—
Pahang	—	—
Total	69	28

The figures for 1913 were 60 cases with 17 deaths.

VENEREAL DISEASES.

Eight thousand and forty-three cases were admitted as against 8,764 for 1913.

Year.	Cases.
1911	6,013
1912	7,506
1913	8,764
1914	8,043

These cases are the recently infected and do not include all those who suffer from ultimate results of infection—anyhow they represent but a small fraction of the sufferers in the Federated Malay States where venereal diseases are very prevalent. Eastern races attach but little importance to these diseases unless much pain is caused or locomotion interfered with—even then they very often prefer to try and treat them with quack remedies. The Principal Medical Officer, Protector of Chinese, Senior Medical Officer, Selangor, Health Officer, Kinta, and Dr. Day formed a Committee and made some recommendations to Government on this subject.

OPERATIONS.

	Major.	Minor.
Perak	326	1,543
Selangor	278	769
Negri Sembilan	296	1,351
Pahang	9	382
	909	3,945
1911	284	1,490
1912	908	2,614
1913	732	2,757
1914	909	3,945

LUNATIC ASYLUMS.

The Superintendent, Central Lunatic Asylum, Dr. Samuels, in forwarding his fourth annual report of the asylum, reports as follows:

	Males.	Females.	Total.
There remained at the end of 1913	400	98	498
Admitted during 1914	343	42	385
Discharged	135	25	160
Absconded	18	1	19
Died	72	11	83
Transferred	1	0	1
Remaining on 31st December, 1914	517	103	620

In addition, there were criminals, all males, remaining at the end of 1913	22
Admitted, 1914	16
Discharged	8
Absconded	2
Died	2
Remaining on 31st December, 1914	26

The total remaining therefore of all classes is:

Males.	Females.	Total.
543	103	646

The total increase is therefore 126. Made up as follows: males, 117; females, five; and criminals, four.

This large increase is partly accounted for by a large number of chronics having been transferred from Selangor and Negri Sembilan.

Admission.—Of the admission, 191 males were direct and 151 transfer. In other words, 191 admissions were from Perak and 151 from the other States.

It may appear strange that, though the Central Asylum is a Federal Institution, there are two classes of admission, one for Perak State and another for the remaining States. This is, however, due to the method at present in vogue of keeping patients in certain centres for a variable time before transferring them to Tanjong Rambutan, and then, in many cases, sending them in batches, some large and some small. The size of the batches, I am happy to say, has diminished very considerably, thus giving one some chance of examining, and becoming acquainted with, the various patients. The delay has not been lessened very much. This is particularly noticeable in one district, where, in spite of remonstrance, it still happens that two months elapse between the certification of a patient and its transfer here.

This is partly due to the defective Lunacy Act, which was passed long before a Central Asylum or treatment of mental disease was thought of, partly other causes into which I cannot enter.

I am glad to say important modifications in the Act are at present under consideration, and, if accepted, should to a great extent remedy the present evil. It will, however, be necessary also to have the cordial co-operation of the Medical Officer and Medical Practitioners if the greatest benefit is to be obtained for the patients.

Amongst the females all were direct admission, as, though two of the admissions were from other States, they happen to come from districts where all concerned have done their best to minimise the delay inevitable at present.

When we come to study the recovery rate it will be seen how important this matter of early treatment is.

Discharges.—On analysing the discharges we find that amongst the females 25 were discharged, of these 23 were discharged recovered.

Of the males, from direct admissions 90 were recovered, and from transfers 28.

Recovery rate.—The recovery rates are as follows:

Females	54.76 per cent.
Males, direct admissions (Perak)	47.12 ,,
Transfers (other States)	18.42 ,,

It is only necessary to glance at this table to see the disadvantage under which the States other than Perak labour.

This recovery rate is exceptionally high, and will be extremely difficult to live up to. It is extremely gratifying, but may lead to disappointment in other years, when the rate is lower.

As to the reason for the high rate this year I cannot offer an explanation.

While on the subject of discharges I should like to allude to the assistance given to discharged patients by the "After-care Association," which is composed of leading men of each nationality, from which our patients are drawn. This association, under the Chairmanship of the Protector of Chinese, Ipoh, helps discharged patients, who have no friends, or no work to go back to, to find work on leaving the asylum.

It has done very good work during 1914, and I hope in the future to be able to arrange for branches in the other States.

We have found employment as grass cutters, etc., for six discharged patients, and at present four are employed here. The only difficulty in employing ex-patients is that it is not advisable to employ them in the wards, and outside the wards there are few appointments.

Absconding.—The number of patients absconding is extremely high, I regret to say, but this can be, to a large extent, attributed to the fact that during the whole year building has been proceeding which necessitates openings in the fences, and the continual passing backwards and forwards of tukans and bullock-carts; so that the opportunities for escape were numerous. In a few cases, however, the escapes were directly due to carelessness on the part of attendants, necessitating in some cases dismissal. There were no escapes from the farms.

The two escapes amongst the criminals are a mystery, which, though enquired into both by myself and the police, have never been cleared up.

It is to be hoped when the additions to the Institution have been completed that this high rate will cease, but until then I cannot hold out much hope of improvement in this direction.

Deaths.—The total deaths numbered 85, two of these being criminals. The deaths amongst the males, excluding criminals, 72, and females 11.

The death-rate was 9.22 per cent.

The commonest causes were as follows: dysentery, phthisis, general paralysis of the insane.

Dysentery (30 deaths) was extremely prevalent, in fact too prevalent, and, in spite of all efforts, is still present. It was principally, in fact almost wholly, on the male side. The difficulties were largely increased by the number of patients admitted suffering from this disease. I have now, after making necessary repairs, begun to send all cases of dysentery to the Infectious Disease Ward, thus completely isolating them. It is too early to say what effect this will have, as it was not until December that I was able to make these arrangements.

Phthisis was the next most common cause, accounting for 15 deaths. This is what one would naturally expect, as asylum patients are very prone to develop phthisis.

General paralysis of the insane takes third place, appearing nine times. There can be no doubt now as to the presence of this disease in this country.

Several cases were admitted in an extremely bad state, and four died within a week of admission.

Fatal accidents.—There were two deaths from ruptured spleen, and I believe I can fairly describe them as accidents.

In one case a patient was extremely excited, dancing, shouting, and gesticulating as he commonly did. He suddenly fell, and on the attendant reaching him, was collapsed. He died within a few minutes, and the post-mortem showed a large rent in a greatly enlarged spleen. The evidence in this case is quite clear, and convincing that there was no blow struck by any one. What probably happened is that the man slipped, and fell, and in his fall struck the edge of his bed.

The other case was that of a patient who snatched some tobacco from another patient, and ran away. The owner of the tobacco followed the thief and struck him. Result: collapse—death—post-mortem, a very large spleen ruptured.

In neither case could any blame attach to the attendants, as an excited patient may slip and fall at any time, and accident of an enlarged spleen could not be prevented. In the other case quarrels between patients arise with the utmost suddenness, and are comparatively common, and their prevention in many cases is absolutely impossible. So that one has only to be thankful that ruptured spleens are not more common.

Post-mortem.—Post-mortem examinations were made in the case of 70 deaths. Of the remaining 15, nine were Muhammadans, in the case of the other six the friends refused permission for post-mortem.

Suicide.—I am happy to say there have been no suicide during the year, though there have been many attempts. This, I believe, points to the fact that the attendants are paying more attention to their duty. Though sleeping on night duty is still too common, in spite of the fact that this offence is invariably visited with punishment, and if frequently repeated leads to dismissal.

Transfers.—There was only one transfer—*i.e.*, a man to the Leper Asylum.

Forms.—The commonest form of insanity amongst the admission is again melancholia, which appears 79 times. Next in order is mania 61, and confusional insanity 60 times. This latter appearing so frequently is due, to a large extent, to the number of cases due to malaria, which, though they may be either depressed or exalted, show as their most marked future confusion.

Alternating insanity appears on 22 occasions. This, I believe, is too high, but owing to the marked difference between the notes taken before transfer, the certificate, and the notes taken here, nothing was left to me but to return them as alternating. As it was only after prolonged observation they could be definitely proved to be of some other type.

General paralysis of the insane appears 12 times. It may be interesting to mention that there is at present in the asylum a woman, who has been fed regularly with the nasal tube since 9th September last. At first I fed her myself, but soon handed her over to the matron, who has fed her ever since.

Aetiology.—Turning to the ætiological table we find malaria appearing, either as a principal or contributary cause, on 35 occasions. I am convinced that malaria is, in this country, a very potent cause of insanity, although I saw in the public press a supposed interview with a medical man, in another tropical country, in which it was denied that malaria was a cause of insanity. In this interview, however, the medical man was reported to have described malaria as "merely an exciting cause," which to my mind acknowledges the fact that it is a cause.

As a matter of fact in our cases malaria was returned as a cause in many more instances than the 35 shown in the return, but I could not satisfy myself in the other cases that it really was so.

Syphilis appears 28 times, but the number of syphilitic histories is far in excess of this number, though again I could only satisfy myself in 28 cases that syphilis could be honestly blamed. Alcohol appears 24 times and the number of Chinese in whom the attack can be attributed to alcohol is remarkable. Opium was also blamed in a few cases, but, though I have accepted it, I am very doubtful if it really exists as a cause.

"Gastro intestinal system" appears 11 times. Intestinal parasites, I believe, are in some cases to blame. Certainly in two cases the improvement after the expulsion of round worms was very marked. So convinced am I now of the importance of intestinal parasites that an examination of the fæces is made in the case of every admission, as well as an examination of the blood and urine.

Privation and starvation appears ten times against two occasions last year. The war is to a great extent to blame for this, as at the commencement a number of coolies were thrown out of work, and suffered considerably. The condition of some of them on admission was pitiable in the extreme. Most of these cases were admitted in the end of August and in September. It is interesting to note that in one case delusions were coloured by the war. The man saying that he was once protected from his enemies by the Germans. That though Chinese, he might with equal truth be called a German, and that when discharged he would go to Germany.

Another man attributed his attack to fear that the Germans would come here as he heard they had sunk some British ships. Yet another amused himself by making a "popping" noise with this month, and informing me that it was German guns.

A remarkable fact to be noticed in the ætiological table is the almost complete absence of heredity as a cause. This is due, I believe, to the fact that many of the Chinese are strangers in this country, and the person who fills the form knowing only the patient himself and is quite ignorant of his family history. Again there is a considerable disinclination to acknowledge insanity, owing to the stigma unfortunately attaching to the insane even in this country. There were several cases which I am almost sure had an insane hereditary, but the relations and friends denied that there ever was such a thing as a case of mental disease in the family before.

In many cases the forms sent out to patients' relations or friends asking for information failed to reach the person to whom it was addressed, and was returned by the post office marked "addressee unknown." In a considerable number of these cases on the forms being then sent through the police they were returned filled up. The police appearing to be a better medium for the delivery of correspondence than the post office. As a rule, when the friends were found, they returned the forms filled up more or less completely.

Criminals.—It will be noticed I have not included the criminals in the above tables except in the case of death-rate.

The criminals now live quite apart from the other patients, No. VI having been turned into a criminal ward.

Delusional insanity was the commonest form, and there is no doubt but that it is the form that most commonly leads to serious crime.

Two criminals were found not insane.

One interesting case of feigned insanity was tried early in the year. Though the man appeared in last year's return as not insane and was discharged in 1913, the trial did not come on till January, 1914, when the man was convicted of murder.

One trouble with the criminals is the difficulty of getting rid of them, when declared fit for discharge, and there is still one awaiting removal who was reported "not insane" on 8th December.

The two escapes amongst the criminals have already been alluded to.

Farms, etc.—The farm has done very well during the year, and supplied 50,000 katis of vegetables, the greater part in the second half of the year. In 1915 we should be able to supply quite five-sixth of the vegetables consumed, and by 1916 we should be able to supply all our demands In October, a second farm, to accommodate 20 patients, was opened, and a considerable amount of ground as already been cleared and planted. Early in the new year it should commence supplying vegetables.

It is a remarkable fact that with all the escapes, there have been none off the farms. Patients have now and then wandered, but have returned in a few hours of their own accord. I hope to open another farm next year, and have already selected the site.

The cows supplied over 5,000 pints of milk. I am not quite satisfied with the cattle, and, seeing that we went to the expense and trouble of importing them, might reasonably have hoped for better results. Only one cow came up to the averge supply of a local cow. There has been considerable trouble in feeding them, and towards the end of the year some of them were in extremely poor condition. They are, however, now improving. I have planted some Guinea grass, which has done very well, and I hope will prove a success as fodder. The cattle certainly appear to appreciate the little we have so far been able to give them. Two of the cows have unfortunately miscarried, why, I cannot say, nor is the Veterinary Surgeon able to give an explanation for this, as he agrees. unusual occurrence. Of the others the first is due to the calf early in February, and the rest should follow from that at variable intervals.

The pigs have more than repaid the money spent on them. The first litters of young ones, however, were a great disappointment, as there are only four surviving, and I fear one of these will not last long. It has been so far kept alive by spoon feeding. First litters are, however, commonly failures, and four sows are now in young and should litter in April.

The fowls have not done well, but, as they cost nothing, every little is clear profit. A number of hens were killed, I believe, by an attendant, whom I had to remove from his charge for not bringing in the eggs. As I could not prove to a Court that he had killed the hens I did not prosecute him, and had to be content with getting rid of him, there being no doubt in my own mind as to his guilt.

Most of the fruit came from the female side, and as a considerable quantity has been planted during the year, the output should be considerably increased next year.

The building staff was employed all the year in repairs, and new buildings. That they did a considerable amount of work can be seen from a glance at the table of work attached.*

The Clerk of Works has kindly estimated the value of the work and puts it at $2,342.55.

A large amount of filling of swamps, clearing, and drain cutting has been done, nearly one and half miles of drains having been cut. This important work is still proceeding, and by the end of next year practically all swamps should have disappeared.

I have been experimenting on sub-soil drainage, and have used all sorts of waste material in the building. It is too soon yet to comment on their efficiency.

All the firewood for the use of the asylum was supplied by the wood-cutting gang.

Needlework.—During the year all the patients' clothing was made in the workroom, as well as the female attendants' uniform. All the pillows were also made there. A large amount of mending was also done.

A glance at the table of work attached will show that the needles were not idle during 1914.*

Taking the patients' clothing (new work) alone, and calculating the cost at ten cents per piece, it will be seen that this item alone means a saving of $422.

Expenditure.—The estimated expenditure for the year was $68,098, the actual expenditure $56,427.39, giving a maintenance rate on average daily number $122.21 per annum per patient. The expenditure per patient treated is $63.09.

Attendant staff.—The attendant staff has been, on the whole, satisfactory. Several cases of dismissal occurred amongst them, but in almost every case it was amongst those of under one year's service. It appears that the first year is the most critical, and that once weathered the attendants settle down to steady work.

The first examination was held in January, and the results were quite satisfactory, in fact amongst the male attendants very satisfactory. The first places were obtained, on the male side, by Head Attendant Kesari, who made a particularly good examination, and on the female side by Night Attendant Natilda.

A new class has attended lecture this year, and the examination will be held next month.

The staff.—I am glad to report that the staff has been most satisfactory, and has worked with a will all through. In fact the recovery rate is a tribute to the work done both by the staff and the attendant staff, as, without their keen co-operation, nothing could be done. Much depending upon them in this respect.

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* Not printed.

Mr. Ampalavanar sat for the preliminary examination for the Medico-Psychological Association Nursing Certificate in November. We shall not know the result for some months as the papers had to go home. He, however, did excellently in the oral and practical part, the Coadjutor, congratulating him on his answering, remarked that he had never met a dresser with a better knowledge of his work.

The long expected Assistant Medical Superintendent has not yet arrived, though his salary was voted from 1st January. The home authorities failed to obtain a man, and, as a consequence, I am still alone, and am feeling the strain very much. I hope, however, when I return from leave that I shall be no longer single-handed.

MEDICAL INSTITUTIONS.

	Hospitals.	Gaol hospitals.	Lunatic asylums.	Leper asylums.
Perak	17	3	1	2
Selangor	13	1	1	1
Negri Sembilan	7	1	–	–
Pahang	5	4	–	–
Total	42	9	2	3

NUMBER OF IN-PATIENTS TREATED.

	No.	Deaths.	Per cent.
Perak	45,595	3,811	8.35
Selangor	31,754	3,048	9.59
Negri Sembilan	17,054	1,405	8.23
Pahang	6,211	360	5.79
Total	100,614	8,624	

as compared with 100,660 and 8,653 deaths for last year.

The following list gives details of nationalities:

——	Perak.	Selangor.	Negri Sembilan.	Pahang.	Total.
Europeans	252	283	133	20	688
Eurasians	53	129	81	18	281
Chinese	23,582	15,293	9,187	3,377	51,439
Malays	2,209	1,149	1,139	631	5,128
Indians	19,282	13,980	6,303	2,009	41,574
Others	217	920	211	156	1,504
Total	45,595	31,754	17,054	6,211	100,614

The out-patient attendances = 276,175.

	Hospitals and dispensaries.	Travelling dispensaries.
Perak	92,641	41,175
Selangor	78,164	—
Negri Sembilan	32,185	1,775
Pahang	27,523	2,712
Total	230,513	45,662 = 276,175

The figures for 1913 are as follows:

	Hospitals and dispensaries.	Travelling dispensaries.
Perak	74,817	49,769
Selangor	66,907	—
Negri Sembilan	31,278	668
Pahang	26,210	1,941
Total	199,212	52,378 = 251,590

Two thousand seven hundred and sixty-nine Malays attended Kuala Pilah Hospital as out-patients against 2,600 in 1913. A Malay dresser from Seremban Hospital visited the kampongs in Seremban district once a week and dispensed medicine to 1,056 patients, and a dresser from Tampin Hospital did the same at Kampong Batu to 610 patients. The Medical Officer at Pekan also paid visits to the kampongs on the Coast and treated 1,768 patients.

REPORTS OF THE LADY MEDICAL OFFICERS.

Reports are forwarded for information of Government; they indicate a satisfactory commencement of useful work amongst native women.

Malay women are very conservative and it will take time to make them understand the advantage of abandoning crude practices—the Negri Sembilan Malays appear to be more ready to avail themselves of the Lady Doctor's services than those of other States. It is hoped and expected that with time and patience the skilful work which these ladies can accomplish will be duly appreciated.

The building of women's hospitals at Kuala Kangsar and Kuala Pilah has been commenced.

LEPER ASYLUMS.

There were 699 cases under treatment, 105 died and 31 absconded:

	Treated.	Died.
Pulau Jerejak	269	67
Pulau Pangkor Laut	62	9
Selangor	368	29
Total	699	105

QUARANTINE STATION, PORT SWETTENHAM.

Twenty-two thousand and six immigrant coolies passed through the camp during the year, 13 of whom died in the quarantine station. Last year 62,193 coolies passed through the camp.

Early in August, at the outbreak of war, Indian immigration was stopped and the camp was utilized for the accommodation of Chinese awaiting repatriation. In all 12,093 were repatriated. The new quarantine station was occupied on 5th June; this establishment is designed on novel lines and has been visited by many people interested in such places. The station is circular, each section radiating from a centre where kitchen and store are situated, making the distribution of food, general observation over the whole station and collection of refuse particularly convenient and labour saving. The sleeping sheds are of iron with tile roofs and screened by a verandah; they are fitted with two tiers of bunks and have very ample ventilation, the floor is of concrete and "barrel" shaped so that water used for cleaning purposes rapidly removes dirt and runs off quickly leaving the surface dry very soon afterwards. These sheds are comfortably cool during the day and provide adequate shelter from wind and rain during the night and therefore are much appreciated by occupants. The drainage from each section is kept absolutely separate and does not mingle with the drainage of any other section until it is outside the boundary of the station. Latrines consist of a cement trough sunk in a cement floor, short moveable planks are placed transversely over the trough for squatting upon—the bottom of the trough is divided into sections by means of a small cement lip, so that a pool of water 2½ inches deep is found under each squatting place, each lip is carefully sloped on the upper side so that flow of water is not impeded—a flush tank is erected at the end of each trough which sluices at regular intervals. A hospital, disinfector and adequate staff accommodation complete an excellent establishment.

VACCINATION.

Perak	46,401
Selangor	34,280
Negri Sembilan	11,600
Pahang	5,765
Total	98,046
1911	108,121
1912	108,781
1913	117,629
1914	98,046

The figures for 1914 are lower because immigration was stopped, if the full number of Indians—*viz.*, 62,193 as against 22,006—had been admitted as in previous years, vaccinations would show a considerable increase, so the number indicates satisfactory progress in the country itself.

ESTATES.

The number of estates from which returns are available is 672 against 609 in 1913.

The average number of labourers employed was 176,226, which is 12,711 less than in 1913, they are distributed as follows:

State.	Average labour force.	Estates.
Perak	67,751	294
Selangor	75,631	231
Negri Sembilan	27,782	129
Pahang	5,062	18

	No. of labourers.	Deaths.	Death-rate per mille per annum.
1911	143,614	9,054	62.95
1912	171,968	7,054	41.02
1913	188,937	5,592	29.6
1914	176,226	4,635	26.3

State.	Death-rate.
Perak	22.18
Selangor	29.8
Negri Sembilan	34.48
Pahang	16.19

In the broken hilly country malaria is the principal cause of death; in flat lands lack of good water is largely responsible for sickness.

The reduction in death-rate is satisfactory, and as the figures for population and deaths are known the calculations can be accepted with confidence.

Several causes contributed towards this diminution in mortality—anti-malarial measures, attention to the general well—being of labourers which was encouraged in 1912 and has been a matter concerning which managers of estates have taken much more trouble, and further improvements in estate sanitation. There are some estates with a very high death-rate—on the majority of them those responsible are making efforts to reduce it—the causes are not due to neglect of ordinary precautions to secure good health but principally due to locality and the difficulties in the way of undertaking anti-malarial drainage

The Health Officer, Negri Sembilan, reports that recruiting in Negri Sembilan should be done in small numbers and local recruits are often liable to be coolies who have been discharged from estates as being unsuitable for reasons of health—he also says, on the whole, the health on estates has not shown any improvement, rather the reverse. Four estates have a death-rate of over 80 per mille, and five estates have a death-rate among Indians of over 100 per mille.

During the year, the Principal Medical Officer, Government Chemist, and Dr. Whitby, Chemical Expert to a group of rubber companies, formed a commission to inquire into the composition of toddy, the favourite beverage of Indians. Some interesting facts were brought to light—it was curious to discover that toddy would not continue to ferment after about 48 hours and did not become even then a strongly intoxicating liquor—the strongest toddy contained only 8.3 per cent.; alcohol by volume; on the other hand, the prolonged keeping of toddy promoted the formation of considerable quantities of acetic acid—in some samples as much as two-thirds of an ounce of pure acetic acid would be formed in an ordinary bottle of toddy. The disclosure of these investigations on the nature of toddy should be of value to Government. In the first place unadulterated toddy is shown to be a comparatively harmless, beverage, and although it has the reputation of causing intoxication it should not do so except fairly large quantities are imbibed and unless spirit is added to it, and it should be possible to prevent this to a great extent. In the second place prolonged storage of toddy, so that it developes a large content of acetic acid, should be forbidden, a beverage containing so much poisonous acid being very harmful. If toddy manufacture is controlled there is every reason to expect an improvement in health of Indians, especially on estates.

It has been thought that the increase of Chinese estate labourers has contributed towards a lowering estate death-rate, because the Chinaman offers greater resistance to disease than the Indian, but the figures for the year 1914 showing race incidence amongst estate labourers do not seem to support this. In Negri Sembilan, for instance, the great difference between the two death-rates of the town of Seremban should be taken into consideratiom as the gross death-rate is probably largely made up of Chinese labourers belonging to estates, because they leave a plantation and remove themselves to the town when seriously ill.

VETERINARY.

RINDERPEST.

An outbreak of this disease occurred in May at 26th mile, Kuala Selangor-Klang road, there were 54 cases with 30 deaths.

FOOT-AND-MOUTH DISEASE.

Selangor.—With the exception of January, September and October, the disease prevailed all over the State during the year. There was a total of 3,906 cases with 86 deaths. The disease was as usual of the ordinary mild type.

Perak.—Three hundred and thirty-one cases were reported from this State; five died and 209 were destroyed.

Negri Sembilan.—One thousand nine hundred and sixty-nine cases of a mild type occurred amongst cattle in Negri Sembilan with 28 deaths.

There were two separate outbreaks in Ulu Pahang, 1,188 cases were detected with 20 deaths.

SURRA.

There were five cases in Perak, one in Selangor, 20 in Negri Sembilan, and 14 in Pahang.

SWINE FEVER.

Three hundred and forty-five cases with 226 deaths were recorded in Selangor. A severe outbreak was found at Batang Malaka and Gemencheh (N.S.) during August. These places are situated near the Malacca boundary and the disease was introduced from Malacca. Four hundred and fifty cases with 300 deaths were reported to have occurred before the outbreak was discovered, and a number of people had to be prosecuted for not reporting the disease. Fifty-seven cases with 38 deaths occurred subsequently, and at the end of the year the disease had been stamped out. Swine fever also broke out in the Seremban district during September but was confined to certain areas, 271 cases occuring with 193 deaths; the majority of deaths being amongst young pigs.

PLEURO-PNEUMONIA.

An outbreak of pleuro-pneumonia amongst goats occurred in a herd brought from Kedah or Siam to Lenggong in October. Out of 34 goats, 30 died; 12 cases were also reported at Grit.

QUARANTINE STATIONS.

Two thousand six hundred and ninety-seven cattle were imported into Perak North *viâ* Port Weld, Parit Buntar, Selama and Upper Perak as against 4,433 in 1913.

Two hundred and sixty-seven head of Government cattle were treated during the year by the Veterinary Department.

Port Swettenham.—Four thousand five hundred and eighty-four cattle were quarantined at this station, there were 23 deaths.

Bukit Sentul.—Two hundred and forty-three cattle were quarantined and 289 released during the year, including 51 left over from 1913; five deaths occurred and 103 cases of foot-and-mouth disease were treated.

Kuala Kubu.—Seventy-seven cattle were quarantined, there were 53 cases of foot-and-mouth disease, all of which recovered.

Negri Sembilan.—The quarantine stations at Tampin and Port Dickson were completed during the year.

Pahang.—The station at Teluk Sisek is now ready for reception of animals arriving at Kuantan by sea.

The ground for the Raub quarantine station has been selected but nothing further has been done.

In dealing with all these outbreaks the Veterinary Department has shown energy and promptitude, and thus saved greater loss of life amongst cattle. The management of cattle quarantine stations has also been very satisfactory.

PROSECUTIONS.

During the year there were 1,346 police court cases, resulting in 1,254 convictions, and fines amounting to $11,830 were imposed.

METEOROLOGY.

PERAK.

The mean temperature of the air for Taiping and Batu Gajah was 81.50° and 82.50°, respectively.

The highest temperature recorded at Taiping was 96° in the month of May, June and July as against 94° in the months of February, June and October, 1913.

At Teluk Anson and Grit the highest temperature was 95° and 98°, respectively.

The lowest mean temperature was 79.50° at Klian Intan, 80.50° at Gopeng, Tapah and Tanjong Malim.

The highest rainfall was at Taiping, 204.71 inches, the highest annual rainfall recorded for the past 10 years—1914 was therefore an exceptionally wet year.

The Senior Medical Officer, Perak, reports that Taiping seems to be particularly unfortunate in the fact that, notwithstanding its excessive rainfall and abundance of streams in the adjacent hills, the town and outlying villages after a dry spell of some 10 days duration, the supply begins to get scanty and much inconvenience is experienced. During the dry months of July and August the water supply to the town was cut off except for a few hours during the day. There was a serious outbreak of dysentery at Matang and Port Weld, the inhabitants suffered great hardship, water for prisoners at the gaol had to be greatly reduced, and at the hospital much inconvenience was experienced for the same reason. The public bath-houses were temporarily closed when really most needed.

Selangor.

Highest temperature, Kuala Langat, 105°; lowest 60°.

Rainfall:

Kuala Lumpur	122.31 inches
Kuala Selangor	65.68 ,,

Negri Sembilan.

Highest temperature, Tampin, 98°; lowest 68°.

Rainfall:

Seremban	92.68 inches
Port Dickson	51.98 ,,

Pahang.

Highest temperature, Kuala Lipis, 98°; lowest 66°.

Rainfall:

Pekan	108.18 inches
Kuala Tembeling	58.68 ,,

GENERAL

Dr. Fox, in the course of a very useful report, remarks on the value of hypodermic injections of quinine, says that 1,000 have been administered in Perak with good results and that he cannot call to memory a single case of tetanus following injections in Government hospitals—in view of what has been said elsewhere this statement is of value. In Kuala Kangsar the death-rate from malignant malaria amongst hospital patients has been reduced by nearly 50 per cent. per mille and this is attributed to the prompt intra-muscular injections in serious cases. Dr. Fox also includes a report from the Medical Officer, Batu Gajah, disclosing a very good record of surgical and other work, a description of some interesting preparations of treponema pallidum and pertenue carried out by Mr. Lesslar derived from cases of syphilis, and an account of a successful operation performed by the Medical Officer, Telok Anson, on a prolapsed degenerated spleen found in the right iliac region, weighing 2 lbs. 12 ozs.

Dr. McClosky sends a carefully compiled statement for Selangor, Negri Sembilan and Pahang, in it he refers to the rise in spleen rate in Klang from 7.57 to 11.72—to Dr. Hennessy's remark that great care and rapidity of examination of stools for amœbæ in cases of of dysentery is essential, and that the mortality amongst maternity cases brought to the General Hospital, Kuala Lumpur, is still very high, because so many of the women are brought there too late to deal with them successfully.

In all the larger hospitals the training of probationer dressers has been carried out carefully, and the staff have spent much time and trouble in making subordinate officers efficient and capable, a high standard has been demanded of them and is obtained.

The general condition of Medical Institutions throughout the Federated Malay States is very good and creditable to the officers concerned—there is a spirit of keenness to obtain the best possible results amongst all classes of patients—in my opinion the treatment of medical and surgical cases in our hospitals will bear favourable comparison with that found in any other country.

Government has always been ready to provide what is asked for in order to relieve the sick—this is appreciated by the staff and encourages them to take a pride and interest in their work. I have pleasure in acknowledging assistance rendered by the Public Works, Government Architect and the Police Departments during the year.

STAFF.

Principal Medical Officer...	1
Senior Medical Officers	2
Director, Institute for Medical Research	1
Senior Health Officer	1
Medical Officers, Grade I	7
Health Officers	6
Bacteriologist	1
Pathologist	1
Medical Superintendent, Central Lunatic Asylum	1
Medical Officers, Grade II	26
Veterinary Surgeons	5
Chemist	1
Assistant Chemist	1
Lady Medical Officers	4
Travelling Medical Entomologist	1
Assistant Surgeons and Apothecaries	40
Matrons and Sisters	22
Subordinate Medical Staff	273
Subordinate Clerical Staff	67
Veterinary Inspectors and Probationers	16
Sanitary Inspectors	11
Laboratory Assistants	2

Dr. W. H. Fry was Acting Senior Medical Officer, Perak, up to 7th May, 1914, when Dr. S. C. G. Fox returned from leave and resumed duty as Senior Medical Officer, Perak.

Dr. P. N. Gerrard returned from leave and resumed duty as Medical Officer, Kuala Kangsar, on 3rd April, 1914, relieving Dr. A. A. Woods, who went to Lower Perak as Health Officer.

Dr. H. G. Heldbrook was transferred from Ipoh to Kuantan on 30th January, 1914.

Dr. Bruce-Low returned from Negapatam and assumed duty as Medical Officer, Larut, on 10th January, 1914; he proceeded on long leave on 20th August, 1914.

Dr. V. T. W. Eagles was transferred from Seremban on 21st August, 1914, and was granted leave from 30th October, 1914, to join the Expeditionary Force in Europe.

Miss A. L. Palmer was appointed as Nursing Sister on 19th September, 1914.

Assistant Surgeon J. E. Lesslar was promoted to prize appointment on 1st November, 1914.

Dr. Coffey, assisted by Dr. O'Flynn, Lady Medical Officer, was in charge of the General Hospital, Kuala Lumpur, until May, when Dr. Hennessy returned from leave and took over charge.

Dr. O'Flynn was transferred to Kuala Pilah in May and was relieved by Dr. Layman, who again was transferred to Pekan towards latter part of the year.

Dr. Hacker was appointed Medical Officer in May, 1914.

The following Medical Officers were in charge of the European Hospital, Kuala Lumpur, during the year:

Drs. Chambers, Coffey, Hacker and Black.

Sister McCarthy joined the Nursing Staff in September, and Sister Miss Horsley resigned in the same month.

I regret to record the death of Sister Miss Morrissey which occurred in March after a short illness.

District Hospital, Kuala Lumpur.

Dr. Glenny was in charge, assisted by Dr. Eagles, till May, when he was transferred to Seremban.

Negri Sembilan

Dr. C. J. Smith was in charge of Negri Sembilan hospitals, except Kuala Pilah, during Dr. Melbrum's absence on leave. The latter returned in August, and Dr. Smith was transferred to Singapore.

Mr. Ford, Veterinary Surgeon, Selangor, continued to act as Veterinary Surgeon, Negri Sembilan, till 8th February, when Mr. Symonds returned from leave.

Dr. Hart was in charge of Kuala Pilah hospital throughout the year. In May, Dr. O'Flynn, Lady Medical Officer, was appointed to Kuala Pilah and took temporary charge of the female ward until the hospital is completed.

Pahang.

Drs. Skeen and Leicester were in charge of Kuala Lipis and Pekan hospitals throughout the year.

Dr. Masters was in charge of Raub and Bentong hospitals until he went on leave in March and was succeeded by Dr. Chambers.

Dr. Peart, Medical Officer, Kuantan Hospital, went on leave in February and was succeeded by Dr. Holdbrook, who again handed over charge in November on Dr. Peart's return from leave.

Dr. Layman, Lady Medical Officer, was appointed to Pekan in the latter part of the year.

The following officers were absent on leave:

Dr. P. N. Gerrard
Dr. R. Bruce-Low
Dr. Meldrum
Dr. Peart

Dr. D. M. Ford
Dr. Hennessy
Dr, Masters
Dr. Delmege

Sister Miss F. C. Row
,, ,, Pearn
,, ,, Abson

There is no record of any Government officer being invalided to Europe during the year.

BUILDINGS.

Perak.

The new hospital at Ipoh was opened in November, 1914. There is now a second class male and female paying ward and maternity ward, the need of which was greatly felt in the old hospital. The accommodation in the new hospital is for 406 beds as compared with 275 in the old institution. The new hospital is in every way an excellent set of buildings and a distinct advance on hospital construction.

Larut—Quarters for Medical Officer, Taiping; quarters for Veterinary Surgeon; two quarters for Assistant Surgeons; and infectious disease hospital.

Kuala Kangsar—One new 40-bed ward and one six-bed surgical ward.

Gopeng—One 20-bed Malay ward.

Bagan Datoh—Dispensary and dressers' quarters.

Klian Intan—Assistant Surgeon's quarters; quarters for two dressers; and new hospital.

Central Lunatic Asylum—Assistant Superintendent's quarters and Assistant Surgeon's quarters.

SELANGOR.

District Hospital, Kuala Lumpur—Two 40-bed wards and operating theatre.

Malay Hospital, Kuala Lumpur—One 40-bed ward.

Klang District Hospital—Police ward of 20 beds.

General Hospital, Kuala Lumpur—Quarters for Nurse Probationers; female ward and X-ray room; and operating theatre.

NEGRI SEMBILAN.

Seremban—Operating theatre, European Hospital.

Kuala Pilah—Twelve-bed dysentery ward.

Mantin—Dysentery ward, eight beds and isolation ward.

PAHANG.

Pekan Hospital—Dysentery ward for males and females; and dressers' quarters.

Raub—Dysentery ward; forty-bed ward; and female ward of 12 beds.

Bentong—Dysentery ward of 12 beds.

REVENUE AND EXPENDITURE.

The total revenue collected during 1914 was as follows:

Perak	$30,048.59
Selangor	37,726.91
Negri Sembilan	14,084.17
Pahang	9,593.59
Total	$91,453.26

The total expenditure of the department under personal emoluments, other charges and special expenditure amounted to $1,642,908.32. Expenditure for 1913 was $1,763,307.52.

MALARIA ADVISORY BOARD.

At a meeting of the Board on 2nd March, it was decided to drain a defined area on Terentang Estate, Negri Sembilan, an intensely malarious plantation; this place was selected as having the most suitable features for a demonstration on the value of rural anti-malarial work; the drainage of the area is approaching completion and eventually a full report will be issued.

Charts showing malaria incidence in Kuala Lumpur Sanitary Board area and at the police barracks are enclosed; the figures which are carefully taken at the barracks, week by week, are a convenient indicator of the condition of the model drained area, although still exposed to some infection from the Batu Road swamp, yet the returns for malarial fever are most encouraging. Those who have opportunities of judging what occurs in the model area generally state that the conditions as regards malaria are very satisfactory.

Dr. Wellington, Health Officer, Selangor, has made searches for anophelines in the model area and failed to find any except a few amongst some weeds at the edge of Sidney Lake. Recommendations have been made for improvement in drainage in other places but as these will be dealt with exhaustively in a report by the Board it is not necessary to include them here.

Anopheles Maculatus is now a comparatively rare mosquito in Kuala Lumpur; whereas in 1910 it was the commonest anopheline in the valleys and accounted for much of the fever in the European residential area. The absence of this mosquito is no doubt due to the extensive sub-soil pipe draining, which has done away with the spring water pools and streams which formerly were so plentiful.

This is, however, not the only malarial carrier and the survey shows that there are still a great many places on the flat land and at the sides of streams which need attention.

Batu Road swamp is still a danger spot. The Government have filled up their portion of the land but nothing has been done on lot II, belonging to a private person. The larvæ of the following anophelines were recently found there: *A. Rossi*, *A. Kochi*, *A. Barbirostria*, *A. Sinensis*, *A Albirostris* and *A. Fuliginosus*. The last three are proved malaria carriers.

No drainage work was done by the department in Perak, but surveys were made of Gopeng and Batu Gajah, a scheme and estimate being made and passed by the Malaria Advisory Board for the drainage of the latter.

One thousand eight hundred and sixty-three feet of concrete drain and 8,537 feet of sub-soil pipes were laid in Pudu Dam at a cost of $4,772.82. This was paid for by the Executive Engineer, Town, from vote for Java Street extension and filling Pudu Dam.

The Executive Engineer, Mr. F. D. Evans, went on leave on 11th March, and Mr. H. L. Bennett acted during his absence. Two Assistant Engineers joined the department during the year: Mr. R. G. Trower on 26th February, and Mr. T M. Gordon on 7th May. Subsequent to the latter's arrival, Mr. Mauleffinch was on the staff as a temporary Engineer from 1st February, 1914, to 6th June, 1914.

The unexpended balance on the votes are due to the stoppage of work when war broke out, with the exception of the drainage of ravines at 4th mile, Damansara Road, where the drainage is due to savings on the original estimate.

Details of work done under the supervision of the Executive Engineer, Malaria Advisory Board, during the year will be seen in appendix C.

INSTITUTE FOR MEDICAL RESEARCH.

Dr. Fraser, in his report, notes the results of experiments undertaken to show that beri-beri is not transferred from one individual to another by means of pediculi, bugs, etc.

Some interesting experiments were made to cultivate the leprosy bacillus on media prepared from preserved fish; at the close of the year no culture had been obtained. Twenty-five leprosy inoculation experiments were performed without producing results.

Experiments were conducted with Dr. Kedrowsky's culture which did not give evidence that the acid-fast bacillus of Kedrowsky is the leprosy bacillus.

Dr. Fletcher made investigations to determine if the value of the Wassermann reaction, as employed in the Institute Laboratory for the diagnosis of syphilis, is discounted by the occurrence of positive reactions in lepers—samples of blood were collected from the adjacent leper asylum—the sera were inactivated a few hours after the blood had been obtained and the tests carried out within 24 hours of the time at which the samples were taken—the method adopted was that of Browning, Cruickshank and McKenzie. In the place of the anti-oxhæmolytic system used by the authors of the method an anti-human system was employed; for purposes of comparison, 110 inmates of the District Hospital were examined for syphilis—the results were striking—the percentage of positive Wassermann reactions in the leper group was more than twice as large as that obtained in the control group of non-leprous patients. Dr. Fletcher remarks that, owing to the comparatively small number of cases investigated, it cannot be concluded on these grounds alone that the larger number obtained in the former group was due to the action of some factor other than syphilis. The luetin reaction was also applied to some cases of leprosy—there was not a single positive luetin reaction among the lepers while among a control group there was no fewer than eleven. The evidence of the luetin reaction as applied to these cases of leprosy is negative evidence and too much value should not be attached to it, but, as far as it goes, it is opposed to the view that positive Wassermann reactions in leprosy are due to syphilitic infection.

SUMMARY.

1. One hundred lepers were examined by Browning, Cruickshank and McKenzie's modification of the Wassermann reaction, with positive results in 22 cases. The amount of complement deviated was, in some cases, exceptionally large.

2. In a control group of 110 non-leprous persons there were eleven positive reactions.

3. In only one of the lepers was there visible evidence of former venereal disease but thirty-three of the lepers admitted that they had suffered from syphilis or from chancres, and of these 33, thirteen reacted positively, while only nine of the remaining 66 gave positive reactions.

4. In the control group, 21 admitted former syphilitic infection and of these eight reacted positively—among the remaining 89, who denied syhpilis, there were three positive reactions.

5. There were twelve positive reactions among 44 cases of tubercular leprosy and ten positive reactions among 56 cases of the anæsthetic type.

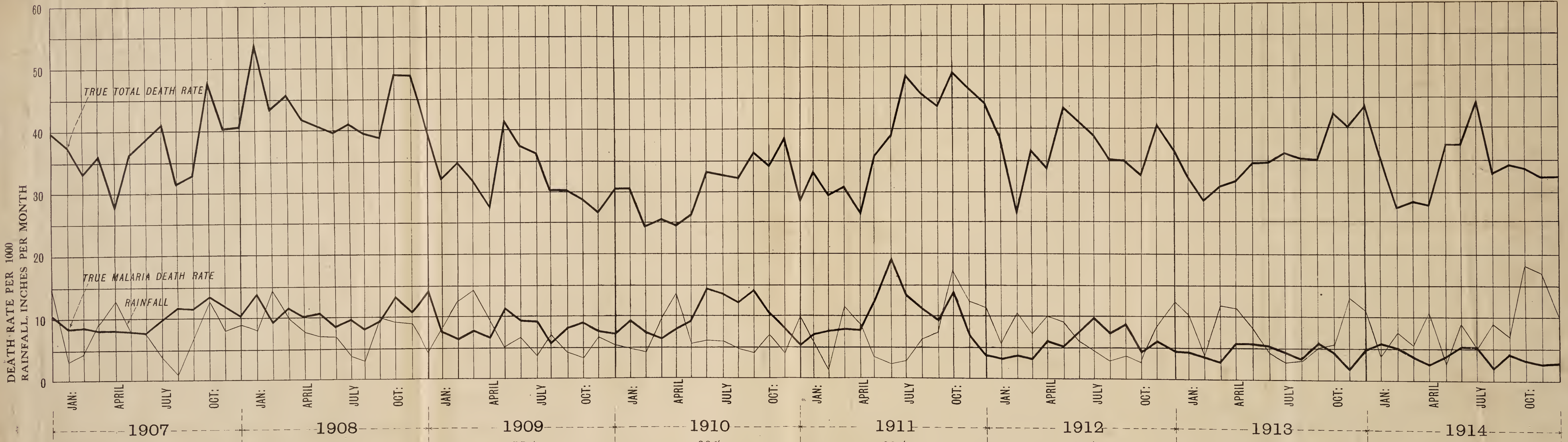
6. The average duration of the disease, among the 22 lepers who reacted positively, was four years and eight months, as compared with an average of three years and eight months for the 78 patients who reacted negatively; but among the latter there were many old-standing cases.

7. Seventeen of the 22 positive cases were in an advanced stage of leprosy and in some of them the disease was progressing; but among those lepers who reacted negatively there were also many advanced and progressing cases.

8. Serum from the lesions in 10 of the lepers who reacted positively was examined by dark-ground illumination but in no case was the *Treponema pallidum* found.

KUALA LUMPUR TOWN

CHART
SHOWING TRUE TOTAL DEATH RATE, TRUE MALARIA DEATH RATE AND RAINFALL MONTHLY.



	1907	1908	1909	1910	1911	1912	1913	1914
Malarial Death Rate for Year	9·7 %	10·7 %	7·7 %	9·8 %	9·9 %	5·8 %	4·2 %	3·9 %

Expenditure on Anti-Malarial Drainage Work.	1908 to 1911 inclusive	1912	1913	1914
Construction	$ 47,705·00	$ 37,526·69	$ 68,459·36	$ 22,314·43
Maintenance	do $ 6,986·85	$ 5,589·51	$ 11,118·07	$ 11,156·69

Total expenditure to end of 1914		
Construction	$	176,005·48
Maintenance	$	34,851·12

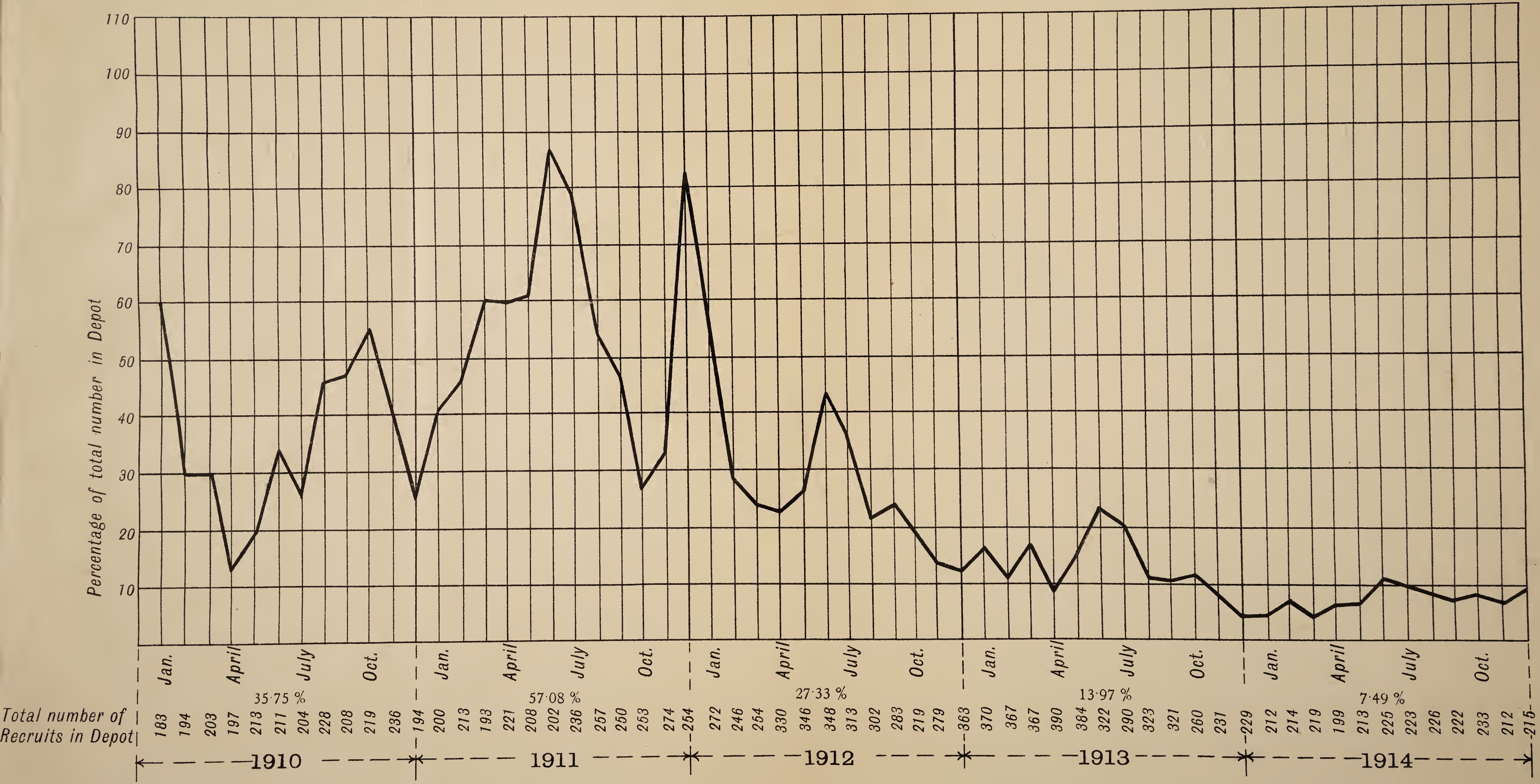
D. EVANS,
EXECUTIVE ENGINEER,
MALARIA ADVISORY BOARD.
F. M. S.

Lithographed at the Central Survey Office, Kuala Lumpur., F. M. S. Reg. No. 188 '15. 150.

KUALA LUMPUR TOWN

CHART

SHEWING PERCENTAGE OF INDIAN RECRUITS AT POLICE DEPOT DETAINED IN HOSPITAL OR GIVEN SICK LEAVE FOR MALARIA EACH MONTH



Lithographed at the Central Survey Office Kuala Lumpur., F. M. S. Reg. No. 188-'15,-150.

9. The luetin test was applied to 21 lepers, with negative results in every instance; thirteen of these cases gave positive and eight gave negative Wassermann reactions. The test was also applied to a control group of non-leprous persons selected because they were likely to be latent syphilitics. In this group there were eleven positive luetin reactions.

THE CONCLUSIONS TO BE DRAWN FROM THE RESULTS.

There were no clinical criteria by which one could foretell the results of the application of the Wassermann test to the lepers who were examined, and, if it be admitted that the positive reactions were due to leprosy and not to syphilis, it is difficult to understand why some tubercular and some anæsthetic cases reacted positively while others, clinically similar, did not; or why some actively progressing cases reacted positively while others as active and as progressive gave negative reactions; but because the determining factor in these reactions has not been demonstrated it must not be concluded that this is necessarily latent syphilis.

The number of positive reactions in the group of lepers was double that which occurred in the control group; but, in the former, a larger number of individuals admitted antecedent syphilitic disease.

A striking feature, in some instances, was the strength of the positive reactions given by the leper sera tested, not once only, but on several occasions. The deviation of complement in such amounts as 50 or 30 doses is, at least, a rare occurrence in latent syphilis.

The negative results of the luetin test and of the search for *Treponemata* are in favour of the view that the positive Wassermann reactions were due to some other cause than syphilis.

On the whole it appears probable, from the results of this investigation, that leprosy, apart from syphilis, may cause a positive deviation of complement when the serum is examined by the method of Browning, Cruickshank and McKenzie.

Leprosy does not cause the luetin reaction to become positive.

Dr. Stanton examined several thousands of specimens of mosquitoes and larvæ sent for identification.

It was observed that the mosquito fauna of the neighbouring islands, Java, Sumatra and Borneo, corresponds closely to that of the Malay Peninsula. The alleged absence of the species *maculatus* and *umbrosus* from Sumatra was found to be an error, specimens of the first of these mosquitoes were taken by Messrs. Robinson and Kloss during their expedition to Korinchi Peak and specimens of the latter by Dr. Schuffner near Medan, Deli.

The larvæ of a number of uncommon jungle mosquitoes were identified for the first time and specimens sent to the British Museum for detailed examination. Differences were observed between the larvæ of the closely related anopheline species, *sinensis* and *barbirostris*, which permit their specific identification. A new species of larva, related to *Anopheles culiciformis* of India, was obtained from the water in cut bamboos but no specimens of the adult insect have so far been taken.

A new species of *Anopheles* was recorded from the Lampongs, Sumatra, and a new species of *Phlebotomus* (*P. stantoni*, Newstead) from the Federated Malay States.

The precipitin test for the origin of blood stains was carried out in connection with various medico-legal cases.

The Director calls attention to the impression that apparently prevails that effective extermination of rats can be accomplished by use of one or other of the so-called rat viruses; he points out that, time and again, it has been shown that these viruses, in the conditions met with in actual practice, will not produce the results claimed for them that they are not inocuous to man—unsatisfactory results were obtained in Africa, and in India the use of viruses has long since been abandoned.

BACTERIOLOGY AND PATHOLOGY.

The following examinations were carried out in connection with material submitted by medical and veterinary officers:

Blood films for malaria parasites, trypanosomes, etc.			198
Films of pus and other exudates for various micro-organisms ...			63
Direct examinations for *Tremonema pallidum*			25
Serological tests			570
(*a*) Widal reactions—			
B. typhosus	112,	positive 48	
B. paratyphosus	2	,, 0	
M. melitensis	1	,, 0	
(*b*) Wassermann reactions...	455		
Bacteriological examinations by culture			239
Fæces for *B typhosus*	2		
,, *V. choleræ*	59		
,, *B. dysenteriæ*	130		
Urine for *B. coli*, etc.	14		
Water for excretal organisms	15		
Pus cerebro-spinal fluid and other exudates for various micro-organisms	19		

Bacterial vaccines were prepared from twelve cases and improvement or cure is stated to have followed their employment in treatment.

A number of worms alleged to be parasitic in man were received for identification. In several cases these proved to be well-known free living forms with which human fæces had become contaminated by accident.

Tissues received for examination numbered fifty-two. One specimen of nasal polypus was found to contain the protozoon, *Rhinosporidium kinealvi.* In three cases the negri bodies of rabies were identified. Other tumour tissues call for no special comment.

CHEMICAL EXAMINATIONS AND INVESTIGATIONS.

The total number of articles examined during the year was 1,182 as compared with 1,067 during the year 1913.

They may be classified as follows :

1.	Criminal investigations	44
2.	Toxicological analyses	49
3.	Opium and chandu	18
4.	Chandu dross	59
5.	Deleterious drugs (morphine and cocaine)	166
6.	Waters	133
7.	Milks	189
8.	Alcoholic liquors	49
9.	Coins and coining materials	441
10.	Miscellaneous analyses and special investigations	34

I.—Criminal Investigations.

Thirty-two articles were examined for blood stains, and one sample of hair submitted for examination was found to be human hair.

The articles examined for blood stains included articles of clothing, knives, parangs, choppers, keys, grass, etc.

In 19 cases no evidence of the presence of blood was obtained. In four of the 13 cases which gave positive reactions for mammalian blood, the stains were identified by the precipitin test as those of human blood.

Eleven articles were received for examination for seminal stains.

2.—Toxicological Analyses.

Of the articles received for toxicological examination 32 were human viscera, and in 25 cases no evidence of the presence of any poisonous substance was obtained. In the remaining seven cases the following poisons were found :

Alcohol in two specimens ; Quinine in one specimen ;
Strychnine in one specimen ; Arsenic in three specimens.

Arsenic was also found in the stomach of a bullock, in a white substance, in a weed killer, in some pieces of sugar cane, and together with the alkaloids of datura in a brown powder.

Viscera and other substances for toxicological examination are frequently received in unsuitable and imperfectly sealed vessels ; and in some cases, preservatives, themselves poisonous, have been added. In such cases, when the method of sealing and forwarding the exhibits has not precluded tampering during transit, evidence of the presence of poison would be quite valueless in criminal proceedings.

3.—Opium and Chandu.

There was a large decrease in the number of these analyses. Twelve samples of chandu examined were all found to contain chandu of Government manufacture. Five samples of pills contained opium, and in one sample of pills no opium or morphine was found.

4.—Chandu Dross.

Of the 59 samples of chandu dross examined, 43 were submitted for the estimation of morphine.

In one case dross was found to be mixed with sand, and in another case dross was largely adulterated with a heavy residue from tin mining.

5.—DELETERIOUS DRUGS.

There was a small increase in the number of these examinations. Of the 145 powders analysed, 123 were found to contain morphine hydrochloride and one morphine sulphate. In some cases the drug was fairly pure, but in many it was mixed with some cheap adulterant, usually milk sugar. Cocaine hydrochloride was found in six powders, in all cases in a state of great purity. Of the fifteen powders containing no deleterious drug, three consisted of quinine sulphate. Fifteen samples of pills were found to contain morphine hydrochloride. The remaining articles examined consisted of Chinese scales, hypodermic syringes and porcelain bowls. In all of these morphine hydrochloride was found to be present

6.—WATERS.

There was a considerable increase in the number of waters examined. The systematic examination of the Taiping supply was continued and a number of well waters from Taiping were also analysed. During the latter half of the year both sources of supply of Kuala Lumpur have been analysed twice a month.

Samples of the river water from Alor Star were examined during the outbreak of cholera in Kedah, and were found to contain an excessive amount of salt. Samples of water from wells sunk by the railway engineers at Alor Star also contained so large a quantity of salt as to render them quite unsuitable for steam-raising purposes.

7.—MILKS.

There was again a decrease in the number of milks examined, following a large decrease in 1913. Only ten samples were found to be adulterated with water.

The systematic investigation of the milk supply of Kuala Lumpur, with a view to obtaining a milk standard, was resumed but was again discontinued in August. The problem is complicated by the fact that the milk is obtained partly from cows and partly from buffaloes, and the milk of these two animals differs considerably. For the results to be of value, daily analyses should be made of the morning and afternoon milks obtained from individual cows and buffaloes. Hitherto it has not been possible to do this.

8.—ALCOHOLIC LIQUORS.

There was again a considerable decrease in the number of alcoholic liquors examined, following a large decrease in 1913.

Twenty-four samples were analysed completely, nine for alcoholic strength only and four samples of stout were examined for adulterants. No foreign matter was found but the samples were deficient in alcohol.

Nine samples of toddy were examined.

9.—COINS AND COINING MATERIALS.

There was a very large increase in the number of articles examined. The number of coins analysed was 337 as compared with 177 in 1913. Of these, nine were of correct weight and contained the correct weight of silver. The remainder all consisted of an alloy of copper, antimony and tin, and no silver was found in any of them. The 104 other coining exhibits included unfinished counterfeit coins, moulds, plaster of Paris, spoons made from an alloy of copper, antimony and tin, pieces of this alloy, pieces of zinc, solutions of acids and of potassium cyanide and stained clothing.

10.—MISCELLANEOUS AND SPECIAL INVESTIGATIONS.

The miscellaneous analyses included samples of rice from North Borneo and Kedah, a deposit from the boiler tubes of a steam launch, samples of bread, tinned salmon, salted fish, yeast, wine, minerals, and an incrustation from the inlet and outlet channels of Ampang reservoir.

The special investigations included the analyses of samples of fresh milk already mentioned. A number of analyses were made of toddy obtained from local shops and in some cases direct from the tree. These experiments were undertaken for the Toddy Committee, with a view to fixing a standard for toddy. It was found that the alcoholic strength and also the acidity increase on keeping, at first rapidly, afterwards more slowly to a maximum which, in the case of the alcohol, is reached in three or four days. The alcoholic content then appears to decrease slightly while the acidity continue to increase slowly.

During the year a preliminary inquiry was undertaken as to the characters of the bacilli commonly associated with dysentery in this country.

At the request of the Kedah Government an inquiry into a serious outbreak of cholera was undertaken by Dr. Stanton.

Cholera vibrios were isolated from a number of cases of the disease, from the intestinal discharges during life—from the gall bladder and intestine post-mortem.

Experiments were carried out to test the inability of freshly isolated cholera vibrios in water from various sources. A series of observations showed that such cholera vibrios inoculated into water drawn from the river at Alor Star could be recovered from it as long as eighty days thereafter and that they were unchanged in their essential characters; similar numbers of cholera vibrios inoculated into similar quantities of Kuala Lumpur tap water were dead in less than 24 hours in nearly every case. A precise explanation of this remarkable difference was not obtained though some evidence was forthcoming that it was related to the content of waters in inorganic salts rather than to their content in organic matter. It is intended to pursue this line of inquiry if a suitable opportunity again offers.

A means was devised for supplying to Medical Officers remote from the facilities of a laboratory the results of a bacteriological examination of material from suspected cases of cholera. Tubes of a medium favouring the growth of the cholera vibrio were supplied to Health Officers. Inoculations of the dejecta were ready for examination by the time the tubes reached the Institute. Even in those cases which did not furnish a pure culture it was found that the mixed growth could be tested by means of a cholera immune serum and the presence or absence of the specific vibrio speedily determined, the necessity of isolating the vibrio in pure culture before identification was thus done away with and valuable time saved in the recognition of the disease in new areas.

During the year 59 cases were examined with 20 positive results.

Dr. Fletcher continued his researches on the luetin reaction in syphilis with a fresh supply kindly forwarded by Dr. Noguchi. In one group of 130 individuals, 79 cases the reaction was positive and 51 negative. the proportion of positive results was least in primary syphilis, greater in secondary and greatest in the tertiary stage. Results of the Wassermann reaction were compared with those of the luetin test in 100 patients; results were as follows:

(1)	Primary syphilis, 7 cases—Positive	Wassermann	reactions	6
	,,	Luetin	,,	... 3
(2)	Secondary syphilis, 36 cases—Positive	Wassermann	,,	... 29
	,,	Luetin	,,	... 24
(3)	Tertiary syphilis, 66 cases—Positive	Wassermann	,,	... 35
	,,	Luetin	,,	... 48

It appears that the action of luetin is specific: positive results occur only in syphilis; but, in cases of this disease, the proportion of positive reactions observed here was much smaller than that obtained by Noguchi.

The results of the luetin test in the group of syphilitics examined in the course of this investigation were not so frequently positive as in the cases examined by Noguchi and other observers in America. This divergence of results is probably due to: (1) the deterioration from storage of the sample of luetin employed here; (2) difference in the methods of treatment in force in the Federated Malay States and the United States of America, respectively.

No positive reactions were obtained in persons free from syphilis; they occurred in syphilitics only.

The luetin test is so easily carried out that it would be of the greatest use in general practice if one could always decide, from the results of its application, whether a patient were, or were not, free from syphilis. Unfortunately, this is not the case, for while a positive reaction is of great significance, a negative result does not exclude syphilis.

When performed in conjunction with the Wassermann reaction the luetin test is of great value: in the early stages of syphilis the Wassermann reaction and, in the later stages, the luetin reaction is most constantly positive. In the great majority of instances one or other reaction is positive; but, in a given case, even though both reactions be negative, syphilis is not absolutely excluded.

The following reports and returns are attached:

A. Appendix to report of Superintendent, Central Lunatic Asylum. *
B. Reports of the Lady Medical Officers. *
C. Malaria Advisory Board—Details of work done during 1914 and charts.
D. Report of the Travelling Medical Entomologist.
E. Report of the Institute for Medical Research. *
F. Return of Diseases.

CHARLES LANE SANSOM,
Principal Medical Officer, F.M.S.

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* Not printed.

ANTI-MALARIAL DRAINAGE, 1914.

KUALA LUMPUR.

DETAILS OF WORK DONE UNDER SUPERVISION OF THE EXECUTIVE ENGINEER, MALARIA ADVISORY BOARD.

Item 8, page 80. Federal Estimates, 14. Federal Expenditure.

	Provided.	Expended.
Maintenance of anti-malarial drainage	$5,000 ...	$2,595.80

Details of Expenditure on Maintenance of Anti-Malarial Drainage.

1.	Cutting grass and surface clearing	$1,791.02
2.	Making good surface and repairs	185.25
3.	Relaying and clearing choked pipes	176.10
4.	Clearing masonry drains and sumps	62.35
5.	Laying new drains	157.50
6.	Concrete drains (repairs)	24.20
7.	Tools, cooly lines, etc.	199.38
		$2,595.80

MAINTENANCE OF DRAINS, EXPERIMENTAL PLANTATION, 1914. KUALA LUMPUR.

Item 1, page 55. Federal Estimates, 14. Federal Expenditure.

	Provided.	Expended.
Maintenance of drains in experimental plantation	$1,500 ...	$1,476.30

Details of Expenditure on Maintenance of Drains in Experimental Plantation.

1.	Cutting grass	$ 882.35
2.	Making good surface and repairs	66.60
3.	Relaying choked pipes	146.90
4.	Laying new drains	305.95
5.	Tools, cooly lines, etc.	74.50
		$1,476.30

DRAINAGE OF RAVINES AT 4TH MILE, DAMANSARA ROAD.

Item 50a, page 83. Federal Estimates, 14.

	Provided.	Expended.
Drainage of ravines at 4th mile, Damansara Road	$5,500 ...	$3,544.96

Details of Expenditure on Drainage of Ravines at 4th Mile, Damansara Road.

1.	Clearing and stumping	$ 4.95
2.	Cutting drains and laying pipes	774.47
3.	Turfing and making dams	1,102.91
4.	Extra earthwork	825.80
5.	Pipes	435.44
6.	Sumps	85.04
7.	Repairs	316.05
		$3,544.96

Length of piping laid 5,754 lin. ft.

DRAINAGE OF RAVINE AT 1ST MILE, BUNGSAR ESTATE (GOVERNMENT).

Unprovided.

	Provided.	Expended.
Drainage of ravine at 1st mile, Bungsar Estate (Government) ...	$2,780 ...	$2,747.18

Details of Expenditure on Drainage of Ravine at 1st Mile, Bungsar Estate (Government).

1.	Survey	$ 67.75
2.	Clearing and stumping	106.40
3.	Cutting drains and laying pipes	1,505.11
4.	Extra earthwork	330.10
5.	Turfing	113.96
6.	Pipes	623.86
		$2,747.18

14,000 lin. ft. sub-soil drains.

DRAINAGE OF RAVINE AT 1ST MILE, BUNGSAR ESTATE. (S.F.D.C.)

	Provided.	Expended.
Drainage of ravine at 1st mile, Bungsar Estate	$5,650	$5,310.98

DETAILS OF EXPENDITURE ON DRAINAGE OF RAVINE AT 1ST MILE, BUNGSAR ESTATE.

1.	Laying pipes and cutting drains	$1,879.47
2.	Extra earthwork	688.38
3.	Sumps, etc.	657.27
4.	Turfing	118.60
5.	Pipes	1,450.43
6.	Repairs	516.83
		$5,310,98

27,130 lin. ft. sub-soil pipe laid.

ANTI-MALARIAL MEASURES.

Item 17, page 38. Selangor Estimates, 14. Selangor Expenditure.

	Provided.	* Expended.
Anti-malarial measures	$22,000	$16,014.55
Sub-soil pipe drains laid	38,446 lin. ft.	
Masonry drain laid	3,917 ,,	

DETAILS OF EXPENDITURE ON ANTI-MALARIAL MEASURES.

1.	Surveys	$ 276.90
2.	Clearing jungle and stumping	1,332.90
3.	Cutting drains and laying pipes	4,403.15
4.	Turfing	439.68
5.	Masonry drains	3,131.75
6.	Tools and materials	614.23
7.	Earthwork	1,815.71
8.	Pipes	2,780.11
9.	Supervision on Terentang drainage	470.12
10.	Given to Sedgeley Estate	750.00
		$16,014.55

MAINTENANCE OF ANTI-MALARIAL WORKS.

Appendix G, page 57. Selangor Estimates, 14. Selangor Expenditure.

	Provided.	Expended.
Maintenance of anti-malarial works	$10,000	$7,084.59

DETAILS OF EXPENDITURE OF MAINTENANCE OF ANTI-MALARIAL WORKS.

1.	Cutting grass	$2,743.07
2.	Relaying choked pipes	1,004.65
3.	Clearing drains and sumps	1,026.79
4.	Making good surface	626.74
5.	Laying new pipe drain	705.45
6.	Tools, cooly lines, etc.	954.86
		$7,084.59

TERENTANG DRAINAGE.

	Provided.	Expended.
Government	$13,250	
Estate	13,250	
Total	$26,500	$22,963.87

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* $2,000 re-voted from 1913.

DETAILS OF EXPENDITURE ON TERENTANG DRAINAGE.

1.	Clearing	$ 252.60
2.	Cutting drains and laying pipes	7,114.04
3.	Earthwork	2,396.40
4.	Turfing	462.22
5.	Cutting main stream	2,257.00
6.	Lowering sill of bridge	1,842.38
7.	Concrete dams and drains	1,252.75
8.	Pipes	6,979.90
9.	Tools for upkeep	57.85
10.	Contingencies	141.33
11.	Upkeep	207.40
		$22,963.87

Re-vote applied for	$ 3,532.98
Unexpended balance of estate vote	3.15
Expended	22,963.87
	$22,500.00

SEREMBAN TOWN. DRAINAGE OF UPPER LAKE.

	Provided.	Expended.
Upper Lake drainage	$2,766.44	$1,377.34

Pipes (sub-soil)	$ 240.78
Sump	27.64
Turfing	33.39
Cutting drains and laying pipes	313.80
Earthwork	551.20
Pipes under embankment (renewal of broken pipes)	210.53
	$1,377.34

SUMMARY OF EXPENDITURE, 1914.

Federal. (Kuala Lumpur Town.)

Construction.	Provided.	Expended.	Sub-soil pipe drains, lin. ft.
Anti-malarial drains	$ 5,500	$ 3,544.96	5,754

MAINTENANCE.

Maintenance of anti-malarial drainage	$5,000.00	$2,595.80
Maintenance of drains, experimental plantation	1,500.00	1,476.30
	$6,500.00	$4,072.10

TOTAL COST OF CONSTRUCTION AND MAINTENANCE.

Construction	$3,544.96
Maintenance	4,972.10
	$7,617.07

SUMMARY OF EXPENDITURE, 1914.

Selangor. (Kuala Lumpur Town.)

Construction.	Provided.	Expended.	Sub-soil pipe drains, lin. ft.	Masonry drains, lin. f
Anti-malarial measures	$22,000	$16,014.55	38,446	3,917
1st mile, Bungsar	2,780	2,747.18		
	$24,780	$18,761.73		

Maintenance ... $10,000.00 ... $ 7,084.59

TOTAL CONSTRUCTION AND MAINTENANCE.

$18,761.73
7,084.59
$25,846.32

WORKS DONE FOR PRIVATE OWNERS.

	Provided.	Expended.	Sub-soil pipe drains, lin. ft.
1st Mile, Bungsar Estate, Societe F. des Caoutchoucs vote	$5,650	$5,310.93	27,130

MALARIA BOARD BUREAU, KUALA LUMPUR, F.M.S., 1ST MARCH, 1915.

My main work has, of course, been on the biology of the anopheline mosquito, the research which you in 1912 asked me to carry out.

This research, as in a research on the biology of any creature, resolves itself into observations on the *habitat* of the mosquito with the correlated physiographical conditions, in fact with every circumstance of mosquito environment, to paraphrase Dr. Bentley. This necessitates a preliminary study into the principles of geology, mineralogy, chemistry, phytology, zoology, meteorology, and in fact almost every ology. That is all that the research is, but as these diversities of environment not only need study in themselves, but also are so numerous, and their combinations almost infinite in number, it is really a very lengthy one. When one comes to think that Dr. Watson has only committed himself to practically two statements with regard to it in thirteen years, it will be seen that it is not a subject to be lightly talked about, and I am sure no scientist worthy of the name would venture to do so, with Dr. Watson's example before him, without a thorough examination of all the factors concerned ; and I hope it is Government's pleasure that I should do so.

With the ideal stated above I have continued my observations this year mainly in the *sawahs* of the Negri Sembilan, first in the Malacca river valley, and then in the Muar river valley, staying at Tampin, Tebong, Batang Malaka, Gemas, Rompin, and Kuala Pilah. I also visited Rembau, and now consider that I have nearly enough observations on that part of the country. I also made short visits to Port Dickson, Terentang, Ulu Gombak, Morib and Jugra.

I am greatly indebted to the many gentlemen who have taken an interest in my work, and put all facilities in my way for collecting information.

Unfortunately, my observations were restricted to the first seven months of the year, owing to the outbreak of the war.

With regard to the study of the morphology of the mosquito which stands in relation to the biology, as the A B C to writing, I have discovered that the larva of *Nyssomyzomyia ludlowi* is distinct from that of *Nyssomyzomyia rossi*, and have sent for publication to the *Bulletin of Entomological Research* a paper dealing with the comparative structure of the two species. I have, moreover, prepared a "Short Key to the Anopheline Larvæ of the Peninsula," as a sequel to that on the adult flies, previously published. It is to be hoped that it will soon be published. It is illustrated by drawings from Miss O'Connor's pen. During the year my paper on the rare larva, *Lophoscelomyia asiatica*, appeared in *Parasitology*.

On the epidemiological side of the question I have sent for publication to *Parasitology* a paper on the outbreak of fever at Morib. I concluded at Morib that the fever there was truly endemic, and I recommended measures directed to exterminating the great numbers of *N. ludlowi* to be found there. I have since found a very interesting new form of anopheline at Morib which, quite probably, is the cause of some of the fever. This anopheline comes midway between *Umbrosus* and *Aitkeni* in point of structure. Experiments are now being directed to determining its pathogenicity. If it prove pathogenic, the discovery will have been important, because *Culiciform* mosquitoes are not usually suspected, and, usually, are left alone.

The Morib outbreak was the subject of a special report, and other local reports were made concerning the area round Kampong Kapor Besar, Port Dickson, and on Kuala Pilah. Another one on the Terentang experiment has been prepared.

I also publish some notes in the *Journal of the Royal Geographical Society* on coast erosion at Morib, which show that man by his works sometimes defeat Nature's ends to his own detriment.

At the Bureau the "millions" have now well settled in the home prepared for them, and are increasing satisfactorily. Interim reports regarding them have been sent to you during the year.

My work on malaria has left scant time for work on other insect-transmitted diseases, but I have collected a certain number of blood-sucking arthropods, I have published in *Parasitology* notes on the blood pathology in cases of East Coast fever, in the *Lancet* "On the Incidence of Plague in Europe," and have sent for publication in the *Bulletin of Entomological Research* a paper on a new species of *Stegomyia* found at Morib.

The Bureau came into occupation in May. I hope it will be a matter of satisfaction to Government that this, which was partly organized as a base for my field work, has enabled me perhaps to treble my efficiency in this matter of collecting observations and materials in my pursuit of fresh knowledge of the incidence of malaria all over the country. I am now getting the materials which I require at as great a rate as I can cope with them. In this, I am glad to say, I am ably and well served by my staff and assistants, who have now been with me some time and have reached a high pitch of efficiency.

It is difficult now to see how I used to get along with all my specimens being taken about the country in boxes.

As I have said, the Bureau has been of great value to me in my researches, but it was hoped that it would fulfil also a useful function in providing knowledge on malaria and disease-producing insects generally to any of the public who wished to utilize the material there.

For this purpose it is necessary to provide specimens for exhibition to various grades of intellect, and this has been done.

The number of visitors has been satisfactory, and Dr. Black found time to do some research in the laboratory in addition to his other duties.

A series of demonstrations were given on the identification of anophelines.

It may be mentioned here that a certain amount of space is available in the laboratory for research workers, and plenty of material on which to work.

In conclusion of this record of a year's work, that I hope, during the ensuing year, to carry my researches into the great tin-industrial regions of Perak and Selangor, with comparative ones on the rubber estates.

THE COMPARATIVE MORPHOLOGY OF THE ANOPHELINES *LUDLOWI* AND *ROSSI.*

Some confusion existing in the minds of medical men in the Malay States as to the differentiation of the anophelines *ludlowi* and *rossi.* I have thought it worth while to give the following comparative notes of the two species, particularly as I believe that the larva of *ludlowi* has been previously held to be indistinguishable from *rossi,* whereas it is in reality very distinct.

My material was taken at Morib, Selangor, to which place I was sent in connection with an outbreak of fever; and I am much indebted to a Zeiss binocular dissecting microscope and to a small *camera lucida* for the figures which I give:

The egg was studied in specimens both laid by mosquitoes and taken from their ovaries when ripe.

In estimating the comparative size of the ova it must be borne in mind that when using the microscope optical sections at the same place must be compared. Perhaps the best way to effect this is to rack the focussing adjustment up-and-down until the *greatest length* of the opaque part of the egg is seen in the species to be compared—the frilled cuticle can be disregarded because it seems to be variable in thickness even at the same plane.

Likewise, the broadest part of the float should be taken for comparative tests. The frilled cuticle varies in thickness, possibly due to foreshortening over different regions of the egg, being especially thick at the prow- and stern-points.

If these precautions are not taken it may appear that two species have different characters in the ova, while they may actually be similar.

It may be mentioned here that we think the usual statement that the floats of the egg contain air is not correct. What seems to be actually the case is that the frilled cuticle as well as the floats attach a thin film of air *on their surface* when placed dry on water.

When eggs are in the egg-sac they are immersed in body fluids, and so when placed in water the water can permeate directly into all the crannies of the cuticle, no surface film of air forms, and the egg sinks.

We found the eggs of the two species indistinguishable in structure, and of practically the same size. The length of the opaque portion of the egg was the same in both cases, the floats were equally broad and the frills of the floats similar in size, and the frilled cuticle also similar in both cases.

The larva was studied in specimens hatched out from the egg laid by gravid females of either species. We found in both species the phenomenon observed by Stanton (1911) that the palmate hairs exist at first as merely buds, which finally open up.

The leaflets of the young larva are always more cylindrical than in the older specimens which are much jagged at the shoulder joint below the origin of the filament, so that, in comparing two species, larvæ of about the same size should be taken.

We observe the following:

1. That *rossi* has its frontal hairs as described by Stanton the *internal anterior* hairs are excessively long and filamentous, the *external anterior* rather variable in length in different individuals but usually not much more than a quarter the length of the former, while the posterior hairs, as Stanton first pointed out, lie considerably *within* the *anterior internal,* projecting over the clypeus.

On the other hand, in *ludlowi* the anterior internal hairs are not so excessively long and filamentous, while the posterior hairs invariably in the different individuals lie almost in a direct line with them. They are much finer than in *rossi,* and do not reach further than about the point of origin of the former.

2. The palmate hairs of *ludlowi* are rudimentary on the first abdominal segment, and well-developed from the second to the seventh. In *rossi* they are similar.

3. The relative length of the filament to the leaflet in *ludlowi* a little less than in *rossi,* but the distinction is too fine to be of any practical use.

The larva of *ludlowi* is, therefore, quite distinct from *rossi*.

As a certain amount of confirmation we may note that given either adult *rossi* or *ludlowi* hatch out in our breeding bottles, we found in *every* case, although we need not have expected such favourable evidence, when we examine the larvæ remaining in the bottle, that they corresponded to the types which we now assign to the two species.

The adult. The imago.

In the adult stage we find : (1) distinct palpal banding in the two species—*ludlowi* having a terminal white band succeeded by a black band of nearly equal width, whereafter is the other narrow white band; *rossi* having a terminal white band of much greater absolute length than the terminal band in *ludlowi* succeeded by a very narrow black band, and this by the other white band of similar width to the black band; (2) the size of the mosquito differs. The male of each species is bigger than the female, but the comparative size of the two species, sex for sex, can be judged from the figures. I think the two species can be diagnosed with the naked eye by their size alone.

(3) The general coloration of *ludlowi* is jet-black, rather like *fuliginosus* in this respect, but *rossi* is very light coloured, in fact, with the exception of *kochi*, it is perhaps the lightest coloured mosquito we have.

(4) The leg marking differs—*ludlowi* is as spotted as *maculatus* with the distinction that the spots are golden, whereas in *rossi* there is nothing more than a little tawny mottling due to the black leg scales not completely covering the chitin beneath.

With regard to the imago—it need only be said that in a series of 255, which we examined, there was never a fly which could not be referred to the one species or the other. I think the confusion which exists in the minds of medical men in this country is due to two factors: (1) that the palps when being examined have been foreshortened and the relation of the palpal bands is not seen; and (2) that old specimens of *ludlowi* lose the lustre in the leg spotting, and this is not then well seen, while, on the other hand, the tawny mottling which exists in *rossi* is rather increased in dry specimens, partly due to contraction of the scales over the tawny coloured and partly to denudation.

We thus see that the diagnosis of the two species *ludlowi* and *rossi* can be readily made in either the larval or imaginal stage.

It is satisfactory that this is so with regard to the larva, for diagnosis of the larva in the field saves much trouble is preferable if it is feasible to breeding out the imago.

AN OUTBREAK OF FEVER AT MORIB IN THE FEDERATED MALAY STATES.

Morib being a seaside resort for the jaded European community of the State of Selangor, much consternation was caused when a succession of visitors there went down with fever.

I was thus enabled to visit the place and come to some conclusion as to the epidemiology of the outbreak.

The Endemicity of Fever at Morib.

In the first place, the question of endemicity arose. As to this, I ascertained that two of the cases in the European visitors were first attacked, one a lady, and the other, her little daughter. Of course it is not conclusive that the infection was not contracted elsewhere, for infections such as malaria, for instance, are now known to sometimes arise in the human long before any symptoms reveal themselves.

The other Europeans who went down had all a previous history of fever, and their illness may have been due to relapse of the previous infection by reason of too much cold or fatigue.

But I turned to the native population round about, and immediately found that if the case-rate of a disease is any index to endemicity, then here whatever fever the natives were suffering from was truly endemic. Moreover, Mr. Munro, late President of the Planters' Association of Malaya, who lives here, informed me that fever has always been prevalent and that only the recent large influx of visitors has caused attention to be drawn to it.

The following notes will show the distribution of the cases and the spleen index among the local population in the vicinity of the rest-house.

1. The Government rest-houses. Four Chinese servants were questioned and two admitted that they had had fever while serving here. The head-boy, who had been at the rest-house for four years, had a greatly enlarged spleen.

2. Among the Malay servants living near the rest-house, there were two married couples, each with one child. The men both complained of suffering constantly from fever and one of them had a greatly enlarged spleen: of the women, one only complained of fever, and she had an enlarged spleen; while the children, who had been both born here, had high fever on them when I saw them, and had enlargement of their spleens—one of them was terribly anæmic and cachectic. The examination of the blood of the children was made and parasites of malignant tertian were found.

3. The Chinese landed gentry behind the rest-house. The towkay confessed to an occasional bout of fever, his son said that he himself had never had it, and he had no palpable enlargement of the spleen, and looked a fine healthy chap; while his little sister was also reported never to have suffered, and she had no splenic enlargement. On the other hand, the cooly of the house was always ill, and he had great enlargement of the spleen and looked miserable. The blood of these people were not examined.

4. Among the Chinese shop-people of the village. The village lies about 100 yards from the rest-house as the crow flies, and any day that one went into the houses one could find a half-dozen of the inhabitants prostrate with fever. There were only two children who had been born here, and of these only one had a palpable spleen. An examination of the blood was made in six cases and crescents found in two.

5. Among the Tamil estate coolies who lived in lines adjoining the village. The manager of the coconut estate on which these Tamils worked informed me that they were always going down with fever, and that they then left the village to recover at a spot two or three miles inland. I palpated the spleens of eight of the coolies, and found five with definite enlargement.

6. In a European gentleman's compound, 300 yards away from the village. The *orang puteh* himself suffered from a bad attack of fever when he first came here, while his servants are constantly down with it.

7. Among the Malay kampong population. Three houses were visited. In two of them a little occasional fever among the children was confessed to, although in five cases no spleen was palpable. However, in the third house, under 100 yards away, two children were down with fever and all four seen had enlarged spleen. Crescents were found in two of these cases.

Enough has therefore been said to show that the whole population here is subject to fever, and, further, the fact that the children of the stationary population suffer, and present signs of chronic disease proves, almost conclusively, that the fever is *endemic* here.

THE MOSQUITOES AT MORIB.

It was necessary to establish the point that malaria was endemic here, for otherwise it had been useless to dissect mosquitoes to look for parasites.

My main object was to find out, if possible, which species was or were causing the trouble, and to what extent.

The following anopheline species were taken: *ludlowi*, *rossi*, *umbrosus*, *sinensis* and *tesselatus*.

Now what was the relative importance of these species in the incidence of the disease at Morib? We know that *ludlowi* (Christophers), *umbrosus* (Watson), and *sinensis* (Tsuzuki) have all been incriminated as the actual cause of malaria—*i.e.*, they actually carried the disease under circumstances, but, nevertheless, it does not follow that because any one of these species were discovered at Morib that it was doing any harm.

For instance, I have found *ludlowi*, in great numbers, at Pasir Permatang over the river from Kuala Selangor to mention but one place in the Malay States, and yet the natives never have fever there and none of the children had enlargement of the spleen. Similarly, at Jeram, in Selangor, which is a village which could almost be changed with Morib without anyone knowing the difference except there is an additional Malay fishing community at Jeram, I found large numbers of *umbrosus* in the fishing community's huts, although the spleen index of the Malay children (50 examined) is practically *nil* there.

As for *sinensis*, at Alor Pongsu, in the State of Perak, the manager of an estate told me that at dusk anophelines came over like a flight of locusts, and I had the opportunity of seeing that, figuratively speaking, he was correct. I could easily have caught 100 *sinensis* in five minutes if I had wished to. Nevertheless, the manager's family and the children of the Javanese coolies who lived a few yards away never suffered from fever.

Enough has, therefore, been said to show that although we found three reputed pathophers at Morib, we would not be *a priori* justified in saying that any one was causing trouble at Morib. Now if we knew the relative rate of infection of the different species of anophelines under the circumstances which we are considering, and we knew their relative prevalence at the time, we could with certainty calculate the relative amount of harm that each species was doing, for the other factors are the same for all. For instance, supposing one per cent. of *rossi* and five per cent. of *ludlowi* become infected under the conditions obtaining at Morib, and we should find five times as many 0 *rossi* as 0 *ludlowi*, it is obvious that the greater or lesser relative prevalence of one species exactly compensates for the lesser or greater relative infectivity of that species and that, therefore, the two species are exactly equally responsible for any illness which is occurring.

We, unfortunately however, do not know much of the relative infectivity of the species under review. It would be extremely useful to any country if such figures could be worked out for that country, but as a great number of dissections would have to be made in order to obviate the "errors of random sampling" the research would need a big organization and considerable expense.

If we knew the relative infectivity of the various species, then in any situation we could soon find out the relative amount of harm which was doing by taking a mosquito census.

In coming to any conclusion, therefore, at Morib, we must rely on the restricted data at our disposal which may hold some "error of random sampling," and to more general considerations.

We will, however, first note the relative prevalence of our species. These were captured within a space of nine days :

Ludlowi	236	of which	90 were	♀
Umbrosus	39	,,	38 ,,	♀
Rossi	36	,,	15 ,,	♀
Sinensis	1	,,	1 ,,	♀
Tesselatus	1	,,	1 ,,	♀

What we know of the relative infectivity of these species is as follows :

Ludlowi.—Christophers in the Andamans found 2/53 *ludlowi* infected, and it is thought that the parasites which de Vogel found in a *rossi*-like mosquito were really found in a *ludlowi.* Horne in India has also lately reported finding *ludlowi* infected.

Umbrosus.—Watson says that he has found *umbrosus* infected, but he does not say what proportion he found so, and it is reported that the species has also been found infected in Borneo.

Stanton has noted that of 11 specimens which had been exposed to infection not one was parasitised. I have myself examined several, about six, previously, and never found one infected.

Rossi.—Eysell contends that several observers have found *rossi* infected, but it seems a matter of doubt whether the species had not been confused with *ludlowi.* Stanton has, however, found no infection in 36 dissected.

Sinensis certainly does become parasitised by the *Plasnodium* (Tsuzuki, Kinoshita), and Stanton found two out of 98 specimens which had been exposed to infection growing zygotes.

Tesselatus.—Of this species nothing is known.

To these data must be added the result of my dissections at Morib as follows :

Ludlowi	80	Number infected	0
Umbrosus	38	,, ,,	0
Rossi	13	,, ,,	0
Sinensis	1	,, ,,	0
Tesselatus	1	,, ,,	0

Conclusions on relative infectivity drawn from these figures would certainly be very fallacious; for instance, it will be noticed while Christophers found two out of 53 *ludlowi* infected, not one of 80 which I collected in a spot heavily infected with fever was so.

" We can, nevertheless, say with some certainty that *rossi*, if infected at all, is only so to a much less degree than the others. Further, although *sinensis* has been found to the extent of about 2 per cent. to be infected, yet its presence in great numbers in certain districts without causing any fever is in marked contrast to what we read of the amount of sickness caused by *umbrosus* and *ludlowi*: it is, therefore, probably less infective than these two species. We have only a little indirected evidence which shows that probably *umbrosus* is not so infective as *ludlowi.* "

The evidence is this, there was no fever, we caught large numbers of *umbrosus* in a few minutes, yet at Morib we caught only 39 in nine days and the lesser number is not likely to have caused more fever than the greater. The conditions, as said before, were almost identical. It is, therefore, probable that, at Morib very little of the fever was being caused by *umbrosus* and most of it by *ludlowi*, in other words, in spite of *ludlowi* being twice as numerous, we can conclude it is the more infective mosquito of the two.

At Morib, it would seem when we consider these rough calculations as to relative infectivity with the actual relative prevalence which we ascertained that *rossi* and *sinensis* are both negligible factors in the situation, and this view is borne out by the cases mentioned above, where, in spite of great numbers of these species, there was no fever. The conclusion we came to at Morib was that *ludlowi* was the greater cause of the trouble, not only because of its greater infectivity but also because of its greater numbers than *umbrosus.*

These conclusions by their necessary lack of precision show us how useful it would be if we had an accurate relative table of the infectivity of the different species, for we would then by merely counting the relative numbers of the prevalent species in any place find out exactly their relative culpability, and act accordingly.

With regard to the consideration of preventive measures we may note here that it would seem that greater success might be anticipated from a campaign against a mosquito, which was causing trouble more by reason of its larger numbers than its high infectivity, than against a mosquito which was of high infectivity and low prevalence, for it is obvious that a larger *proportion* of the former type would be found and destroyed. This theorem might account for the great success which has attended anti-mosquito efforts in places of the Federated Malay States like Port Swettenham, and for the comparative lack of results in the hill-country, for in a place like the former, *ludlowi*, the cause of the fever, is a mosquito of relatively low infectivity, but of usually great prevalence. It breeds in enormous quantities, a fact which is probably due to the larval characteristic, as in *rossi*, disappearing at the slightest approach of danger. On the hill land, on the other hand, *maculatus* and *albirostris* are never to be found in such great numbers, but they are of great infective powers.

It is a corrollary to this to say that if fever is easily allayed in any community, by anti-mosquito works, none of the anophelines in such a place are highly infective.

At Morib, therefore, the prospects would seem excellent of greatly reducing the disease by anti-*ludlowi* methods.

Summary.

Consideration of the outbreak of fever at Morib in Selangor, Federated Malay States, impresses us with the great importance and utility of, if we possessed it, an exact comparative infectivity table of the various anophelines compiled on a comprehensive basis; for it is borne upon us by this outbreak at Morib that it is only by accurate measurement of a disease and the factors responsible for it, that the disease can be economically treated.

At Morib we can only rely on general considerations and conclude that the species *ludlowi* was causing most of the trouble.

Further, because it would seem that the reason that hill-land malaria in Malaya, and perhaps in India, is so difficult to get rid of is because it is caused by mosquitoes of high infectivity and low prevalence, whereas on the low-lands malaria can be easily allayed because it is caused by mosquitoes of low infectivity and high prevalence.

It is a corollary to this that if malaria in any community can be easily allayed, it is caused by mosquitoes which are of low infectivity.

MALARIA BOARD BUREAU, KUALA LUMPUR, FEDERATED MALAY STATES.

It will be remembered that when the fish first arrived in this country they were placed in the following situations:

1. In a concrete reservoir on Bukit Rajah Estate.
2. In an earth reservoir on Midlands Estate.
3. In a swamp at Seremban.
4. In a mining hole at Seremban.
5. In a plant-house tank in Sydney Lake Gardens.
6. In a lakelet in Sydney Lake Gardens.

Those on Bukit Rajah Estate disappeared and have not been seen since.

On Midlands Estate the fish likewise disappeared, but subsequently reappeared in a nice little shoal. They have remained here ever since, and have increased greatly in numbers. It is unfortunate that they will now have to be moved, because of the concreting of the sides of the reservoir which is about to be carried out. We owe our thanks to the manager, Mr. Harrison, and to the acting manager, Mr. McGill, for the interest they have taken in this lot of the fish.

With regard to those placed in the swamp at Seremban, it was thought that they would not reappear for many a day because of the extensive nature of the swamp, but a short time ago I visited the place in which they were put and it appeared to me that they had come back. It is possible that I mistook a local species of *Cyprinodont* for our species, for I had no means at hand to catch any for closer examination, but as those I saw were marked with red. as "millions" are, it is quite possible that here we have another culture of "millions" to draw upon.

Those placed in the old mining hole at Seremban disappeared, because the water did. The plant-house tank in the Lake Gardens have been very useful as a sort of nursery where no possible harm could be apprehended for the little fish. They have bred and increased quite satisfactory in this tank, and some still remain there, although most have been removed to stock what is hoped to be a permanent home for them.

Those in the lakelet, as I have already reported, seriously decreased and the survivors were placed in the Gardens tank; none have since been seen in this lakelet.

The next stage has been the building of a special *breeding troughs* of concrete at this Bureau, and fish from the Gardens tank were used wherewith to stock it. They are now here, and increasing satisfactorily.

A few have also been used to stock two of the aquarium tanks which were built for the collection of local fish.

Power of Increase of Millions.

We will here only draw our conclusions on this point from the culture in the Gardens tank. Here the fish were regularly fed, free of natural enemies, and undisturbed for a long period. Yet although we did get thousands where we only placed in tens, nevertheless *millions* were not produced as we had hoped. In fact in spite of all the varying conditions in which they have been placed, they have not proved prolific breeders so far. It is quite possible that we have an exaggerated idea of their powers in this respect.

NATURALIZATION.

To keep such creatures as *millions* alive by nursing them is one thing, to get them to breed while under protection is another (and in both of these we can congratulate ourselves on our success) but to get them to naturalize themselves, to look after themselves, and survive the competition of the natural world is quite another matter.

Each creature, it may be trite to remark, is so finely adapted to his environment—in fact is the complement of his environment—that the *chances* are that he will not survive if taken out of the environment to which he is complementary.

However, we must remember that notable instances of the chances of survival of a creature being *enhanced* have occurred after importation into a fresh environment. The rabbit was an importation into Australia, and the lady-bird insect into California. Each has flourished exceedingly, and I may mention here that although there were local species of lady-bird in California, which were ineffective in stopping the scale disease of plants yet the imported lady-bird not only flourished exceedingly, but was effective in eradicating the scale disease.

The first stage of our experiment with the *millions*, therefore, was to nurse them and to get them to breed, and the next stage has been to try to colonize them in the "natural waters" of the country. In this stage up to date we have, I think, had a notable success in the culture on Midlands Estate. Here the fish are not fed or protected in any way from natural enemies, in fact "big fish" are constantly being caught in the reservoir yet they have increased from 80 to many thousands. This place is just such a one in which "millions" will be placed for anti-malarial work in the future and the outlook is therefore very cheerful. Moreover, if the "millions" have reappeared in the Seremban swamp a great success will have been achieved, for there are hundreds of thousands of acres of similar swamp in this country in which the fish could be placed. We have chosen a very good place at Ayer Angat for an experimental culture in a swamp, and when the situation has been prepared for the fish we will be enabled to proceed a stage still further in our courses. The swamp at Puchong would, I think, offer a further suitable breeding place for the fish.

Altogether the chances seem to me to be very rosy that this little fish will, with care, become one of the indigenous creatures of Malaya.

Whether it will be as successful as was the lady-bird in California when it comes to eradication of disease remains to be seen.

MILLIONS AS LARVA DESTROYERS.

When I came back from Morib on 2nd September I found two of the aquarium tanks (four feet square) swarming with mosquito larvæ. I then put five "millions" in each of the tanks, and by 10th September I could not find a single larva remaining. Each fish must have eaten countless numbers.

Therefore, it is certain that if we can colonize these fish, that they must do some good, even if they only eat one larva each during their lifetime. And when, as Sir Ronald Ross, has shown mathematically, it is not necessary to do more than destroy a certain *proportion* of larvæ in order to completely eradicate malaria, I think the chances that they will prove efficient malaria-preventers are decidedly hopeful where they can be used for that purpose.

To summarize, we have very good evidence that we will be able to naturalize this fish, and *ipso facto* they will be efficient anti-malarial agents.

C. STRICKLAND,
Travelling Medical Entomologist, F.M.S.